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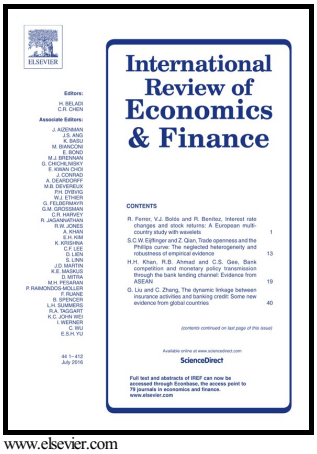

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Bank Ownership, Regulation and Efficiency: Perspectives from the Middle East and North Africa (MENA)

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Abstract

This paper examines the effects of bank regulation and ownership on the efficiency of banks in the emerging MENA region. The public and private view of bank regulation is tested along with the interaction of bank regulation and ownership. Results support the public view of bank regulation and suggest that both ownership concentration and supervisory power individually and interactively exert a positive influence on cost efficiency. Moreover, government ownership, capital stringency and market power have positive effects on cost efficiency, whereas activity restrictions and deposit insurance have opposite effects. Capital regulation and supervisory power improvements occurred since Basel II.

Keywords:
Ownership; bank regulation; bank efficiency; MENA
JEL Classifications:
G21, G28, G32

1. Introduction

This study examines the impact of bank regulation and ownership on the efficiency performance of banks in 12 countries in the Middle East and North Africa (MENA) region using data envelopment analysis (DEA) with a one-step maximum likelihood estimation. It is based on an unbalanced panel dataset covering 718 observations from 132 commercial banks over a period of 11 years (2002-2012). The financial markets are unique in the MENA region as compared to other parts of the world given the higher reliance on bank finance, and a continued high level of government ownership of banks especially in the oil exporting

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countries. Therefore examining the effects of ownership and regulation on bank efficiency in this region is important. The specific research questions are: i) does bank regulation and activity restrictions relate to bank efficiency? ii) does ownership concentration as well as government and foreign ownership influence bank efficiency? iii) does the interaction amongst bank regulation and bank ownership impact bank efficiency?

One important motivation of this study is take the recent global financial crisis (GFC) into consideration in assessing the impact of bank regulation on bank efficiency. The occurrence of the global crisis could directly affect market competitiveness and bank risk-taking, which in turn influence banking efficiency and stability (see Soedarmono et al. 2013). Moreover, the banking reform initiatives in the post-crisis period such as capital stringency and more intense banking supervision might alter risk-taking behavior and efficiency of a bank. Incidentally, the GFC is also followed by the implementation of the Basel II guidelines in the MENA region. Therefore, it would be interesting to see how the Basel II guidelines on bank capitalization, official supervisory power and market discipline influence bank efficiency in the post-crisis period.

Our study adds firstly to the literature by investigating the impact of specific components of bank regulation and supervision on bank efficiency, testing the 'private' and 'public' view theories of bank regulation in the MENA region. Barth et al. (2006) argue that the 'public view' of bank regulation aims to maximize benefits to the general public and minimize financial losses which might impact the public at large, whereas with the 'private' view it suggests that regulation is set up to benefit particular interest groups such as the banks themselves or the politically well connected, which may suggest government owned banks. In prior literature we find that in some cases capital regulation is found to have a positive effect on bank efficiency (Barth et al. 2013; Chortareas et al. 2012), with activity restrictions having a negative effect on profit efficiency. On the other hand, opposite effects of capital regulation and activity restrictions are found by Pasiouras et al. (2009). This study uses data from the World Bank's Global Banking, Regulation and Supervision Survey in 2011. This is the only available global dataset that captures regulatory reform initiatives after the financial crisis.

Secondly we add to the literature by considering the interaction of bank regulation and ownership effects on bank cost efficiency. Ownership effects were examined in the MENA region by Farazi et al. (2011) and Kobeissi et al. (2010), but not with bank regulation. The inter-dependence between bank regulation and ownership structure in explaining bank risk-taking has been examined (e.g. Laeven et al. 2009; Haw et al. 2010) but surprisingly, no studies to date examine the effect of the interaction between ownership and bank regulation on bank efficiency. The ownership of banks is not important in the Basel regulation, even though a bank's ownership structure might constrain the effectiveness of bank regulation (see Laeven et al., 2009). In regards to regulatory restrictions and supervisory practice there might be some regulatory benefits given to government owned banks, but this will not be captured without consideration of ownership and regulation together against bank efficiency. Another consideration here is that ownership is taken as a percentage rather than a dummy variable, meaning that the effects of ownership and regulation together can be measured more effectively. Given bank regulation has a broad application across all bank ownership types, we expect the findings to have policy implications.

The Middle East and North Africa (MENA) region is predominantly bank based, with limited development of equities and corporate bonds other than for some of the Gulf Cooperation Council (GCC) countries (OECD, 2009). For firms in the region, the level of long term debt as a percentage of total debt is extremely low in the MENA region, reportedly to be just 3.41% (Awartani et al. 2016). These features of the MENA financial systems, could be related to corporate borrowers in the region who have often had a level of opaqueness, where controlling shareholders have influenced the disclosure of information which has caused further asymmetric information concerns for suppliers of finance (Koldertsova, 2011). This has been improving though with the introduction of corporate governance standards in the region from 2002, and as part of the resolution process after stock crashes in 2006 with the largest regional stock exchanges in Saudi Arabia, United Arab Emirates and Qatar.[2]

The region is strategically placed between Asia, Africa and Europe with a number of significant trading canals such as the Suez, Hormuz, Bab-el-Mandeb and BiSuez, Hormuz, Bab-

[2] The stock markets in North Africa tend to be very small and less developed.

el-Mandeb and Gibraltar (Bitar et al. 2016). In regards to the rate of transfer of ownership of banks in the region, it is considered low, even though Rocha et al. (2011) report that state ownership of banks has been on the decline and foreign bank ownership on the rise. The banking sector is therefore considered concentrated, with unique ownership and regulatory structures, and monopolistic competition (Turk-Ariss, 2009).[3] The financial systems of the region are bank dominated with family ownership of banks common in the GCC countries, with the government owning a number of large banks (Ben Naceur and Omran, 2011). Within the region, a higher level of financial development is associated with lower levels of government ownership of banks, and more sound prudential regulation and supervision (Creane et al. 2003). We therefore also add to the literature by considering ownership concentration and ownership type effects on cost efficiency.

The findings suggest some encouraging outcomes of the regulatory reform initiatives in relation to capital regulation and official supervisory power on cost efficiency, and thus support the 'public view' theory of bank regulation. However, activity restrictions show a weak negative relationship with cost efficiency, a finding that supports the 'private view' of bank regulation. Consistent with agency theory, ownership concentration is found to have a positive effect on cost efficiency, and that this effect is reinforced through greater official supervisory power. Contrary to the widely-held notion that government control causes greater agency conflicts, this study also finds government ownership having a positive effect on cost efficiency. The study results further suggest that capital stringency and supervisory power appeared to be more effective in enhancing bank efficiency in the post-GFC period. This might be due to the implementation of the Basel II guidelines and improved regulatory efforts in the post crisis era to enforce bank regulation more effectively. The evidence also confirms the significance of the interdependence between internal corporate governance mechanism (such as ownership concentration) and external governance mechanism (e.g., official supervisory power) in explaining bank efficiency. Interestingly imperfect competition does not seem to impede bank efficiency in the MENA region.

[3] The competition-stability hypothesis suggests that greater competition enhances bank efficiency through reducing monitoring costs and portfolio risk of a bank, and thus promotes soundness and stability of a bank (see Turk-Ariss, 2010b).

The rest of the paper is structured as follows. Section 2 provides a review of literature, and section 3 outlines empirical specifications and data. Section 4 provides empirical results and analysis, and section 5 concludes the paper.

2. Literature review

2.1 Regulatory reform and ownership structure in MENA banking:

The regulatory reform initiatives in most MENA countries began in the 2000s under the sponsorship of the multilateral organizations such as the World Bank and the International Monetary Fund (IMF). The Basel Committee provides a structural framework for these initiatives in areas such as capital adequacy, disclosures, risk management, prudential regulation and corporate governance (OECD, 2009). These reforms were intended to reduce bank risk-taking behavior and to improve efficiency.

The adoption of the Basel guidelines in the MENA region has tended to align with the level of sophistication of a country's financial system (Rocha et al. 2011). The IMF (2008) observed that nearly 68% of the Middle Eastern and 55% of the African countries had complied with the Basel core principles. But more recently, Mohseni-Cheraghlou (2012) observed a 92 percent regional compliance with Basel II provisions in relation to the disclosure of off-balance sheet items and risk management framework. The GCC countries have also made substantial progress in relation to higher provisioning rates, tightening of personal loans, and the disclosure and sharing of credit information by financial institutions via public credit registries or private credit bureaus (Ayadi et al. 2013). The supervisory authorities of a number of GCC countries tend to have greater independence, even though they cannot replace management or to declare a bank insolvent. Other major challenges for the region include weak political power of the central banks, poor enforcement of regulatory guidelines, and a lack of effective supervision with limited supervisory expertise (Rocha et al. 2011).

2.2 Theoretical framework:

The theoretical literature about the relationship between bank regulation and bank efficiency is largely inconclusive. There is no underlying theoretical framework of bank regulation and agreement on what should be done to reform regulation (Allen et al. 2013). Two opposing perspectives by Barth et al. (2013) can explain these inconsistencies. Firstly, the 'public interest view' suggests that the government safeguards the interests of the public through regulating banking activities, which in turn promotes bank efficiency and helps to mitigate the prospect of market failures. Secondly, the 'private interest view' suggests that certain bank regulation is enacted or enforced to maximize the interests of a particular group, leading to a decline in bank efficiency. Regardless, there is a need to have a deeper analysis of the appropriate design of macro-prudential bank regulation (Allen et al. 2013).

2.2.1 The public view of bank regulation

Capital regulation is intended to discipline bank risk-taking and to promote bank efficiency. According to the 'public interest view', greater capital stringency requirements can cause entry barriers to newcomers, restrict competition, and force banks to take more prudent lending decisions, leading to greater bank efficiency (Agoraki et al. 2011). Nevertheless, the 'private interest view' suggests that the benefits of excessive capital regulation can be lower than the costs, because of greater rent extraction by governments, together with higher barriers to entry and higher opportunity cost of losing attractive investment opportunities (Barth et al. 2013). Moreover, stringent capital regulation might force owners/managers to pursue costly financing sources such as equity rather than deposits (Pasiouras et al. 2009), and to select a riskier investment portfolio in order to compensate for the loss of benefits from more capital requirements (Laeven et al. 2009), leading to poor bank efficiency. The empirical results on the effect of capital regulation seem inconclusive. For example, Pasiouras et al. (2009) and Sassi (2013) observe an inverse relationship between capital regulation stringency and bank efficiency, whereas Chortareas et al. (2012) and Barth et al. (2013) show a positive effect of capital regulation. Since the MENA region shows significant progress in the implementation of Basel II capital requirements and related capital regulation, this is likely to have brought a more disciplined approach in bank lending decisions, leading to improved bank efficiency. Therefore, we intend to test the following hypothesis:

Hypothesis 1. Capital regulation has a positive influence on the cost efficiency of a bank.

The 'public interest view' suggests that powerful and independent bank supervisors/regulators have the incentive and expertise to enhance bank efficiency and to overcome market failures through implementing effective monitoring and disciplinary mechanisms and enforcing better corporate governance standards (Beck et al. 2006; Barth et al. 2013). On the other hand, the 'private interest view' holds that powerful supervisors can influence banks to allocate credit to maximize private or political benefits (Beck et al. 2006), leading to a decline in bank efficiency. Moreover, as the 'political/regulatory capture' hypothesis suggests, politically connected supervisors may not have the incentive and power to promote bank efficiency through risk-taking restrictions or as a result of rent-seeking behavior of powerful banks in emerging economies (Agoraki et al. 2011). Available empirical literature appears to support the 'public interest view'. Pasiouras et al. (2009) and Chortareas et al. (2012) find that official supervisory power and independent supervisory authorities tend to enhance profit efficiency. Barth et al. (2013) find that supervisory power enhances bank efficiency only in the presence of independent supervisory authorities. Although Rocha et al. (2011) find that the MENA region had poor risk-based bank supervision and a lack of independence of the central bank, Pillar 2 of Basel II may have helped improve bank efficiency given its guidance in regards to bank supervision. Therefore, we expect a positive effect of official supervisory power on bank efficiency in the MENA region. This leads to the development of the following hypothesis:

Hypothesis 2. Official supervisory power is positively associated with cost efficiency of a bank.

Activity restrictions (such as securities and insurance underwriting) are likely to have both positive and negative effects on bank efficiency. According to the 'public interest view', activity restrictions reduce moral hazard problems, discipline excessive risk-taking behavior of a bank, and restrict banks from becoming extremely large and complex that are 'too big to monitor and discipline' (Barth et al. 2013; Laeven et al. 2007). This eventually leads to an increase in bank efficiency. Nonetheless, the 'private interest view' suggests that increased activity restrictions might reduce the benefits of economies of scale and scope in gathering and processing information, providing diversified services to customers, and building reputational capital. Moreover, activity restrictions can reduce the possibilities of risk diversification and the involvement of non-interest income related activities (Agoraki et al. 2011), leading to a

decline in overall bank efficiency. The empirical evidence on this issue appears to be mixed. Barth et al. (2013) and Chortareas et al. (2012) find tighter restrictions on bank activities having an adverse effect on bank efficiency, whereas Pasiouras et al. (2009) find an opposite effect. We predict an inverse effect of activity restriction on bank efficiency, because a higher degree of restrictions reduces the prospects of diversification and non-interest income related activities where the scope of activities may be undertaken in a more efficient manner. Based on this discussion, we develop the following hypothesis:

Hypothesis 3. Activity restrictions are inversely related to cost efficiency of a bank.

Deposit insurance is an important part of the regulatory structure that limits the risk of bank runs and enhances the safety and soundness of a banking system. Despite this, deposit insurance creates a moral hazard problem by limiting a bank's downside risk and encouraging risk-taking (Forssbæck, 2011) with less incentive for insured depositors to monitor bank behavior. This, in turn, can impede bank efficiency in the long-term. Allen and Carletti (2013) question the effectiveness of deposit insurance, and advocate some other alternative mechanisms (such as the lender of last resort policies) to deal with liquidity concerns when a bank run is likely to occur. Since most of the MENA countries do not have explicit deposit insurance, deposit insurance is not predicted to have an impact on bank efficiency.

2.2.2 The 'private' view of bank regulation

Market discipline reduces the detrimental effects of a concentrated banking market and the ensuing risk-taking behavior of banks (Haw et al. 2010). According to the 'private interest view' (Barth et al. 2006, 2013; Beck et al. 2006), appropriate regulatory initiatives relating to the disclosure of reliable, comprehensive and consolidated information on bank activities and risk management practices tend to reduce information asymmetry with the discipline coming from investors and other suppliers of funds, as opposed to regulators. This in turn, enhances the ability and incentive of the private investors to monitor bank activities and governance practices, leading to an improvement in bank efficiency. In support of the 'private interest view', most empirical evidence (e.g., Barth et al. 2013; Pasiouras et al. 2009) find market-based disclosures and monitoring have a positive effect on bank efficiency.

In the MENA region, Bourgain et al. (2012) find that financial disclosure increases the likelihood of a bank adopting sound risk management practices, only in the presence of high financial openness. Nonetheless, Duarte et al. (2008), observe that market discipline mechanisms might have an adverse effect on bank efficiency, because of the direct and indirect costs of extensive disclosures, and the release of sensitive information to the competitors. Further evidence in support of this was found by Chortareas et al. (2012) for European banks. Considering a recent change in the regulation of MENA countries relating to the disclosure of off-balance sheet items and risk management practices (Mohseni-Cheraghlou, 2012), we expect that market discipline has a positive effect on bank efficiency. Therefore, we develop the following hypothesis:

Hypothesis 4. Market-oriented disclosure and monitoring are positively related to cost efficiency.

2.2.3 Ownership and bank efficiency

Haw et al. (2010) argue that agency problems can be severe in the banking sector partly because of concentrated shareholding, which leads to connected lending and relationship banking, leading to lower bank efficiency. Nevertheless, agency theory suggests that ownership concentration enhances cash-flow ownership of controlling shareholders and reduces agency costs (see La Porta et al. 2002), which in turn improves bank efficiency. In support of this argument, Iannotta et al. (2007) find that ownership concentration is associated with better loan quality and lower asset risk. Shehzad et al. (2010) also find that ownership concentration significantly reduces bank risk at low levels of shareholder protection rights and supervisory control. Since the quality of investor protection and bank regulation is relatively weak in the MENA region (Rocha et al. 2011), and ownership is concentrated as a response to poor legal protection of investors (Omran et al. 2008), we expect a positive effect of ownership concentration. Following this, we intend to test the following hypothesis:

Hypothesis 5. Ownership concentration is positively related to the cost efficiency of a bank.

A related literature suggests that government ownership of banks might be justified from the perspective of social welfare arguments and the need to address monopoly power and distributional concerns (Shleifer et al. 1997). Whilst Otchere (2005) argues that government ownership in the financial sector is beneficial in countries with underdeveloped institutions, Haw et al. (2010) find that government control is subject to greater agency conflicts in countries with weak legal and regulatory institutions. Likewise government ownership brings inefficiency because of conflicts between social objectives and political interests, bureaucracy and corruption, and interest group politics (Shleifer et al. 1997). Based on these observations, together with the dominance of government-controlled banks in the region, we expect government ownership is likely to reduce bank efficiency in the MENA region.

Foreign banks face liabilities of foreignness, which includes additional operating costs in overseas markets, and the difficulties in adopting host country norms and practices (Kobeissi et al. 2010). These additional costs related to liabilities of foreignness can lead to lower bank efficiency. However, the 'global advantage hypothesis' suggests that foreign banks might benefit from more advanced technologies, highly skilled labor force and better risk management practices (Lensink et al. 2008). This can assist foreign banks to exploit bank-specific advantages and to overcome the liabilities of foreignness in less competitive host countries (Kobeissi et al. 2010), leading to an improved bank efficiency. Foreign banks often outperform domestic banks in terms of profitability, cost efficiency and competitiveness in developing and emerging economies (Micco et al. 2007). Considering the 'global advantage hypothesis', together with the institutional similarity between the emerging and MENA countries, foreign ownership is predicted to have a positive effect on bank efficiency. Therefore, we intend to test the following hypothesis:

Hypothesis 6. Government ownership exerts a negative influence, whereas foreign ownership exerts a positive influence on the cost efficiency of a bank.

2.2.4 Interaction effects of bank regulation and ownership on bank efficiency

The regulatory environment characterizes how a bank is capable of acting within an economy (Barth et al. 2001b). Whilst some studies (e.g., Laeven et al. 2009) posit that the effect of bank regulation depends critically on each bank's ownership structure, others (e.g., Haw et al. 2010;

Shehzad et al. 2010) argue that bank regulation might constrain the effectiveness of governance mechanisms such as ownership concentration. Understanding how specific regulatory and supervisory practices affect bank performance is important. In the MENA region this is further complicated with the bank dominated financial systems, concentrated banking markets and continued government ownership of banks. The Basel regulation does not depend on bank ownership characteristics, so we therefore test:

Hypothesis 7: The effect of bank ownership on cost efficiency depends on bank regulation, and vice versa.

3. Empirical specifications and data

We use data envelopment analysis (DEA) to estimate cost efficiency, and then apply one-step maximum likelihood estimations to examine the impact of ownership and bank regulation on bank efficiency. Charnes et al. (1978) introduced the DEA method and Banker et al. (1984) extended this method to include variable returns to scale (VRS). This method solves linear programming problems to construct production possibilities of a decision-making unit (DMU) such as a bank, based on the envelopment of multiple input and output variables. Barth et al. (2013) observe that, unlike the parametric technique (such as stochastic frontier analysis), a nonparametric DEA-based efficiency measure is not dependent on the misspecification of the functional form. Banker et al. (2008) also find that DEA-based estimation is superior to parametric techniques in estimating the efficiency of a decision making unit (DMU).

We follow Zhu (2009) in using the following variable returns to scale DEA models of cost efficiency. Suppose the sample is *n* and there are *m* inputs and *s* outputs for each bank. Denote x_{ik} as a $m\times1$ vector of inputs for bank *k*, x_{ij} as a $m\times n$ matrix of inputs, y_{rk} as a $s\times1$ vector of outputs for bank *k*, and y_{rj} as a $s\times n$ matrix of outputs, respectively. Under the linear programming based DEA model, the minimum cost of producing the target output can be expressed as:

$$min = \sum_{i=1}^{m} p_i^k \tilde{x}_{ik} \quad (1)$$

Subject to: $\sum_{j=1}^{n} \lambda_j \, x_{ij} \leq \tilde{x}_{ik} \; (i = 1,2,..,m); \sum_{j=1}^{n} \lambda_j \, y_{rj} \geq y_{rk} \; (r = 1,2,..,s);$

$\lambda_j, \tilde{x}_{ik} \geq 0; \sum_{j=1}^{n} \lambda_j = 1$

Where p_i^k is the unit price of input i , $\tilde{x}_{ik}$ is the i^{th} input that minimizes costs for bank k, and λ_j is the non-negative scalar parameter.

The cost efficiency is then measured as $\frac{\sum_{i=1}^{m} p_i^k \tilde{x}_{ik}}{\sum_{i=1}^{m} p_i^k x_{ik}}$ (2)

According to the DEA method, cost efficiency scores of a bank fall in between 0 and 1. A bank with an efficiency score of 1 indicates an efficient bank as it is located on the efficient frontier, whereas a score below 1 indicates relative inefficiency.

Following Barth et al. (2013) we adopt an intermediation approach to estimate Equations (1) and (2) in terms of four inputs and three outputs. The input variables are: total funding (total deposits + total money market funding + total other funding) ($x1$), total fixed assets ($x2$), personnel expenses ($x3$) and loan loss provisions ($x4$). Whilst the input variables $x1$, $x2$ and $x3$ are similar to those of many other studies, Barth et al. (2013) argue that loan loss provisions should be considered as an additional input in bank efficiency analysis, since it captures risks or potential costs of lending decisions given loan quality. This argument might also be relevant to MENA banking, where loan loss provisions tend to be quite high especially in the state-owned banks (Farazi et al. 2011). The prices of four input variables are the ratio of interest expenses to total funding, the ratio of non-interest expenses to fixed assets, the ratio of personnel expenses to total assets, and the ratio of loan loss provisions to total loans, respectively. The three output variables are: total loans ($y1$), total other earning assets ($y2$) other operating income ($y3$). The prices of the three output variables are the ratios of interest income to total loans, non-interest income to other earnings assets, and the ratio of other operating income to total assets, respectively. In addition, year dummies are included to account for technological changes.

In order to examine the effects of ownership and bank regulation, we follow Lensink et al. (2008), Pasiouras et al. (2009) and Gaganis et al. (2013) in using a one-step maximum likelihood approach (as proposed by Battese et al. 1995) with heteroskedasticity robust standards errors. The maximum likelihood approach provides a valid inference about the impact of firm-specific and country-specific attributes, whilst controlling for other cross-country differences. Accordingly, we use both time and country dummies to account for technological differences over time as well as between countries. Whilst there might be a potential endogeneity problem due to reverse causality, Pasiouras et al. (2009, p.296) argue that the predicted (in)efficiencies are only a function of the environmental variables, and therefore the latter should be included in the first step to obtain unbiased estimators of the parameters. This makes the two-step method unnecessary. Nonetheless, to validate our results, we follow Barth et al. (2013) and Chortareas et al. (2013) in using a second-stage truncated regression estimation based on bootstrapping procedure, as proposed by Simar and Wilson (2007). The evidence from these studies suggests that causality runs from bank regulations to bank efficiency, rather than the other way around. Using cost efficiency scores as the dependent variable, the following regression model is estimated:

$$Eff_{k,t} = \gamma_0 + \gamma_1 CS + \gamma_2 SP + \gamma_3 AR + \gamma_4 MD + \gamma_5 DI + \gamma_6 OwnCon + \gamma_7 Govt + \gamma_8 Foreign + \gamma_9 MP + \gamma_{10} Size + \gamma_{11} EQ + \gamma_{12} Deposit + \gamma_{13} Growth + \gamma_{14} Lending + \gamma_{15} Income + \gamma_{16} GDP + \gamma_{17} Interest + \gamma_{18} Year\ Dummies + \gamma_{19} Country\ Dummies + \gamma_{20} OwnReg \quad (3)$$

$Eff_{k,t}$ is the efficiency score for bank *k* at time *t* obtained from the DEA model. The first five explanatory variables are the proxies for bank regulation such as, capital stringency (CS), supervisory power (SP), activity restrictions (AR), market discipline (MD) and deposit insurance (DI), whilst the following three variables indicate ownership structure namely, ownership concentration (OwnCon), government ownership and foreign ownership. $OwnReg$ is the interaction term for ownership (concentration, government or foreign) and regulation (capital stringency, supervisory power, activity restrictions or market discipline). We expect capital stringency, official supervisory power, and market discipline having positive

associations, whereas activity restrictions having a negative association with bank efficiency. In addition, ownership concentration and foreign ownership are expected to have positive influence, and government ownership is likely to have a negative influence on bank efficiency. For the interaction results we expect that the regulation may differ for different ownership types, to the main results.

This model also includes a bank-level estimate of market power (MP) (measured by the Lerner index) to control for competition. We follow Agoraki et al. (2011) and Turk-Ariss (2010a) in computing the Lerner index (see Appendix A). Based on the theoretical prediction of competition-stability' hypothesis (see Turk-Ariss, 2010b), market power is expected to have a negative association with bank efficiency. In order to control for other bank- and country-specific determinants of bank efficiency, we follow among others, Barth et al. (2013) and Gaganis et al. (2013), in using bank size, equity (EQ), deposit, lending, loan growth, natural logarithm of real GDP per capita (income), GDP growth, real rate of interest and year dummies as control variables. Finally, country dummies are included to confirm that the results are not influenced by the differences across countries. Table 1 provides a detailed description of the variables.

As part of our effort to test Hypothesis 7, we also incorporate the interaction of each of the four bank regulation variables (e.g., CS, SP, AR, and MD) with three ownership variables (e.g, ownership concentration, government and foreign ownership) in our estimation of Eq.(3). In doing this, we follow Agoraki et al. (2011) in reducing multicollinearity problem by 'centring' the variables. This is done by subtracting the mean from each observation, prior to incorporating them into the specifications. In order to measure the impact of the global financial crisis (GFC), we also estimate Eq.(3) with the post-GFC dummy as an additional test variable. In addition, we estimate Eq.(3) for the sub-samples of pre- and post-GFC periods.

3.1 Sample and data:

Due to availability of data, we use an unbalanced panel dataset covering 718 observations from 132 commercial banks based in 12 MENA countries, including six GCC countries (such as Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates) and six non-GCC countries (such as Algeria, Egypt, Jordan, Lebanon, Morocco and Syria). This study uses country-specific and bank-level data over a period of 11 years (2002-2012). The ownership and financial data are collected from the Bankscope database provided by Fitch/IBCA/Bureau Van Dijk, together with the annual reports and websites of the banks.

In addition, we use the World Bank database on bank regulation and supervision (Barth et al., 2001a, 2004, 2008) and the World Bank's bank regulation survey (2011) to construct indices relating to capital stringency, restrictions on bank activities, supervisory power and market discipline. Agoraki et al. (2011) argue that these indices can be more informative than dummy variables to construct a more harmonized measure. Since the World Bank datasets cover several points in time, the 2001-dataset is used for bank observations of 2001-2003, the 2004-dataset for bank observations over 2004-2007, the 2008-dataset for bank observations over 2008-2010, and the 2011-dataset for bank observations over 2011-2012. Moreover, the World Bank's World Development Indicators (WDI), IMF's International Financial Statistics, OECD survey on corporate governance in MENA countries, annual reports of the central banks, are consulted to collect macroeconomic data.

Table 2 shows a highly concentrated ownership structure in MENA banking, with the mean value of highest shareholding being 47% (Panel A), whilst for specific countries with the more concentrated ownership are Algeria and Egypt at 75% and 71% respectively. Jordan Kuwait and Oman have less concentrated ownership. Capital stringency tends to be good in most countries, with the lowest level in Egypt. Saudi Arabia has the most activity restrictions with Qatar the least. Supervisory power is fairly strong in most countries, but less so for Jordan and Kuwait. For market discipline the mean is quite high for the sample indicating incentives to disclose to the market. On a country basis Algeria and Oman have the lowest levels of market discipline.

Table 2 also shows that foreign investors own around 28% shares among the sample banks, whilst overall government ownership is around 15%. In addition, the mean value of the Lerner index is 0.51, indicating the presence of monopolistic competition in MENA banking, and thus supporting the evidence of Turk-Ariss (2010a). Banks in Syria and Algeria have a high level of liquid assets and banks in Syria a high market power. Equity levels are generally quite high in the region with Morocco though reporting 8%. Funding by deposits is very high for Egypt, Saudi Arabia and Lebanon and the highest GDP growth in Qatar. The higher results for liquidity and capital for Egyptian and Syrian banks could relate to the Arab Spring uprising which began in 2010 and also the war in Syria from 2011.

4. Empirical results and analysis

4.1 Estimates of efficiency:

Table 3 shows country-wise distribution of cost and profit efficiency scores of MENA banks. The mean score of cost efficiency of the entire sample is 0.38, suggesting that the degree of cost inefficiency is quite low in the MENA banking sector. The table reveals that banks in Algeria, Saudi Arabia, U.A.E. and Qatar have greater cost efficiency scores than other MENA countries, with the efficiency scores ranging from 0.47 to 0.63. Overall, cost efficiency are lowest amongst banks in Lebanon, Egypt and Syria which could relate to the political issues in these countries. The estimates of cost scores are comparatively lower than those of Olson et al. (2011), who provide an assessment of cost and profit efficiency of banks in MENA countries. The profit efficiency average is 43% which is also low with specifically Egypt, Syria and Lebanon with low results which of course could be related to the political issues in these countries. The efficiency scores are also lower than the estimates of Sassi (2013), who assesses technical efficiency of non-GCC banks. One possible reason for this difference is that we use loan loss provisions and other operating income as an additional input and output variable, respectively.

4.2 Public and private view of bank regulation:

First we consider the results in regards to the public view of bank regulation, that more specific regulation is good for the efficiency performance of banks (Barth et al. 2013). Table 4 shows estimation results of cost efficiency based on a one-step maximum likelihood estimations with heteroskedasticity robust standard errors. Table 5 reports the cost efficiency scores with the same estimation technique but also reported for the pre-GFC and post-GFC time periods based on frontier regressions and truncated regressions. Table 6 reports the second-stage truncated maximum likelihood regression results for cost efficiency, with Tables 7 and 8 reporting the frontier regression results pre- and post-GFC, respectively.

Results for capital stringency appear to have a positive influence on cost efficiency for the full sample period tested in Tables 4-6, but in the pre-global crisis period only Model 3 in Table 7 is positive. For the post-global crisis results in Table 8 the results are all positive, indicating an improvement in the ability of capital regulation to promote efficiency since the implementation of the Basel regulations. These results support Hypothesis 1 and the findings of Chortareas et al. (2012) and Barth et al. (2013) that capital stringency supports bank cost efficiency.

Also in support of the public view that bank regulation is good for bank efficiency, supervisory power has a positive relationship with cost efficiency results for the full sample period (Tables 4 – 6). Similar to capital stringency results though, in the pre-crisis period this particular regulatory measure was not significant (Table 7) but in the post crisis period was significant in Models 1, 4, 5 and 6. This again suggests positive effects from the Basel regulation and supports Hypothesis 2, other than in the pre-crisis period that bank supervisors are able to promote efficient banks in the MENA region. Models 1 and 4 of Table 5 further show post GFC dummy having significant positive effect on cost efficiency, indicating a positive effect of the implementation of the Basel regulations after the financial crisis. Particularly in the post crisis period we do not find evidence therefore for the political/regulatory capture hypothesis in regards to cost efficiency.

The results for activity restrictions by regulators often report a significantly negative result (Tables 4-6) supporting Hypothesis 3 that higher restrictions lead to a lower cost efficiency, reinforcing the findings of Barth et al. (2013) and Chortareas et al. (2012). This is consistent with the arguments of the 'private view' of bank regulation. The crisis sample results though are only significant in Models 5 and 6 of Table 8 for the post crisis period where interaction terms for ownership and supervisory power and ownership and activity restrictions are included. Therefore we find support for Hypothesis 3 except in the pre-GFC period.

Next we consider the private view of bank regulation that effective market disclosure can positively lead to bank monitoring and efficient operations. The results were not as expected with some significantly negative results in Tables 4-6. In the pre-GFC period no significant results are reported and in the post GFC period some negative results are found. This suggests that in the MENA region that public disclosure is not an adequate means to support bank efficiency. Hypothesis 4 is not supported. Therefore we suggest that regulators should focus on bank regulation and supervision to promote cost efficient banks in the MENA region.

Deposit insurance tends to have a negative impact on cost efficiency (Tables 4-6) and in the post-crisis period (Table 8), a finding that is consistent with Barth et al. (2013). This may suggest some moral hazard issues where insured depositors are not motivated to monitor banks, resulting in excessive risk-taking and reduced efficiency of a bank. This result was not expected, given deposit insurance aims to make pay-outs to depositors in the case of bank failure more efficient, but may be due to the fact that many countries in the MENA region do not have deposit insurance.

4.3 Bank ownership and bank efficiency:

Given that bank regulation and in particular the Basel regulation does not differentiate on bank ownership type, then we test if this is important in regards to the efficiency of banks in the MENA region. We had hypothesized that ownership concentration would have a positive influence on bank cost efficiency given the limited investor protection in the region and more concentrated markets, and the results in Tables 4-6 tend to support this view. The results for the

pre-crisis period in Table 7 are not as strong as for the post-crisis sample in Table 8. Therefore, even though the IMF (2008) expresses concerns about the dominance of a concentrated banking sector and a low transfer of ownership in the MENA region, our findings suggest that ownership concentration does not seem to impede cost efficiency. We therefore find support for Hypothesis 5.

We expected that government ownership would lead to a lower cost efficiency due to conflicts with social and political objectives (Shleifer et al. 1997). Our results though tend to support the view of Otchere (2005) that government ownership is beneficial as in this case the cost efficiency results are usually positive (Tables 4-6). In the pre-GFC period results of Table 7 the results were positive, but not so for the post-GFC period (Table 8). This again suggests further potential benefits with the implementation of the Basel regulation and in the follow up period to the global crisis. Foreign bank ownership tended not to be significant in regards to cost efficiency, therefore not supporting the global advantage hypothesis in the MENA region. Overall we find some evidence against Hypothesis 6 in regards to government banks being inefficient in the MENA region, except for the post-GFC period. This suggests that whilst the supporting markets and infrastructure in the MENA region are in the developmental stage, regulators should not push to privatize government owned banks and that foreign banks may not find an advantage in these markets. Foreign banks in the MENA region therefore appear to face a liability of foreignness which was outlined by Kobeissi et al. (2010).

This evidence tends to contradict a widely-held notion that government control causes greater agency conflicts. Whilst this evidence supports Pasiouras et al. (2009), it contradicts Barth et al. (2013) and Chortareas et al. (2012), who find government ownership having an inverse effect on bank efficiency. Farazi et al. (2011) and Kobeissi et al. (2010) also argue that government ownership causes greater political interventions in credit allocations, higher costs, larger loan loss provisions and poor risk management in MENA countries. One possible interpretation is that a strong government influence, together with substantial entry barriers, may cause government banks to enjoy some competitive advantage over foreign-controlled banks in MENA countries (see for instance, Ayadi et al. 2013).

4.4 Interaction of bank regulation and ownership on cost efficiency:

The interaction results of ownership concentration and supervisory power maintain a positive association with cost efficiency for the full sample as well the post-crisis period, suggesting an inter-dependence between internal and external governance mechanisms. This evidence is partly in line the Hypothesis 7, and supports the arguments of related literature such as Laeven et al. (2009) and Shehzad et al. (2010). For government ownership we find a negative result of government ownership and supervisory power on cost efficiency in the pre-crisis period (Models 2 and 6, Table 7) and once in Model 6, Table 4 for the full sample period. This suggests that a higher supervisory power has a negative impact on government banks, particularly in the pre-crisis period. This does not hold for the post-crisis sample in Table 8 suggesting some improvement. In Table 4 we find a positive relationship between government ownership and activity restriction but the individual results for government ownership was positive, whilst activity restriction had some negative results. This result was not supported in Table 6 or the pre/post-crisis samples.

The interaction results for foreign banks are interesting. We find that in Models 4 and 5 of Tables 4 and 6, that the interaction of foreign bank ownership and capital stringency has a negative effect on cost efficiency. The same effect is supported in the pre-crisis period of Models 3 and 4 in Table 7, but does not hold for the post-crisis sample (Table 8), again suggesting improvement in regulation. For the interaction of foreign bank ownership and supervisory power we find a negative relationship in Models 6 of Tables 4 and 6, and in Model 6 of the post-crisis sample in Table 8. Unlike our other results which often tend to report an improvement with the onset of the Basel regulation and post crisis period, the interaction of foreign bank and supervisory power result suggests that regulators in the MENA region should consider the effects on foreign banks, although our results are not consistent where all bank regulation and foreign bank interactions are included.

Interestingly, the bank level estimate of market power (i.e. the Lerner index) shows a statistically significant positive association with cost efficiency (Tables 4-8). This evidence contradicts Barth et al. (2013) and Chortareas et al. (2012), who find lower competition (as measured by HHI) being inversely associated with bank efficiency. In a study on developing

economies, Turk-Ariss (2010b) find market power of a bank having a positive association with profit efficiency, amid insignificant relationship with cost efficiency. This result supports the argument that powerful banks in more concentrated markets (such as the MENA region) can exploit the benefits of imperfect competition by setting higher lending rates and lower deposit rates (see Pasiouras et al. 2009). Overall, this result appears to contradict 'competition-stability' hypothesis, and supports the arguments that a bank with higher market power may reduce information asymmetry problem, improve loan quality portfolio and enhance bank stability (see Turk-Ariss, 2010a). Among the other control variables, loan growth and bank lending show positive associations with cost efficiency, whereas bank size, interest rate and GDP per capita are inversely related to cost efficiency often in the full samples and the pre-GFC sample (Table 7). But in the post-crisis sample of Tables 5 and 8, lending and interest rates were less significant.

4.5 Profit efficiency results:

Although not the main focus of this paper we did consider profit efficiency using the same inputs and outputs as per the cost efficiency analysis. Frontier regression results are reported in Table 9 and it can be seen that for many of the variables, the results are not significant. Some slight negative results are obtained for foreign banks on profit efficiency, and for deposit insurance. In regards to bank controls, market power, bank size and loan growth had positive effects whilst, lending had a negative effect on profit efficiency. For the interaction results, government ownership and market discipline led to a positive effect on profit efficiency, whilst foreign ownership and market discipline led to a negative result. In Table 10 the post-GFC dummy suggests a negative impact. In the pre-GFC period (Model 2, Table 10) ownership concentration had a positive effect and foreign ownership a negative effect on profit efficiency but these did not continue in the post-GFC period (Model 3, Table 10).

4.6 Robustness tests and further investigation:

We undertake a robustness test with estimates of Equation (3) using a one-side censored Tobit model in order to allow for a restricted range (between 0 and 1) of efficiency values. The estimation results are not reported but available on request. Although the focus of our paper is different, we examine if the Arab Spring had an impact on bank efficiency in MENA countries. We look into the estimation results (not reported) of each of the country dummies that are used in every specification. We find that the country dummies for Egypt and Syria show statistically significant negative associations with cost efficiency for the whole sample period as well the post-crisis period, indicating some support for an inverse effect of the Arab Spring bank efficiency in countries such as Egypt and Syria. This evidence supports Ghosh (2016) that shows the Arab Spring having an inverse effect on bank profitability and a positive effect on bank risk in the MENA region.

5. Conclusion

This study examined how ownership and bank regulation individually and interactively influence bank efficiency in the context of 132 commercial banks from 12 MENA countries. The cost efficiency results supported the public view, rather than private view of bank regulation, meaning that in the MENA region bank regulation aids in the efficient allocation of resources better than bank disclosure where the market may discipline banks (i.e. the private view of bank regulation).

Bank regulation results had positive effects on cost efficiency in the post global crisis period and full sample period, suggesting improvements in the post-crisis period which also saw the implementation of the Basel framework. For specific bank regulation type effects on efficiency we find that capital regulation had a positive effect on cost efficiency, but not in the pre-global crisis period. In a similar fashion, official supervisory power had a positive influence on cost efficiency, but again not in the pre-global crisis period. Also with bank regulation that restricts activities of banks had the expected negative influence on cost efficiency, but not in the pre-global crisis period.

In regards to ownership, we find some influence on bank efficiency. Ownership concentration is positively related to cost efficiency, but for profit efficiency only in the pre-global crisis period. Surprisingly, government ownership of banks had a positive influence on cost efficiency, but not in the post-crisis period, and not for profit efficiency. Foreign banks appeared to not have any advantage in the MENA region which does not support the global advantage hypothesis. Interestingly, the bank-level estimate of market power (a control variable) shows a positive association with cost and profit efficiency, indicating that imperfect competition in the concentrated MENA banking market does not seem to impede bank efficiency.

The interaction results of ownership concentration and supervisory power seem to indicate an interdependence between internal (e.g., ownership concentration) and external governance mechanisms (supervisory power). The interaction results between bank ownership type and bank regulation resulted in some interesting findings particularly for government owned and foreign banks. For government owned banks, the interaction of government ownership and supervisory power had a negative influence on cost efficiency in the pre-global crisis period but not significant post-crisis. This was not expected as individually these characteristics had a positive influence, but the results suggest improvement in the post-crisis period. The interaction of foreign bank ownership and regulatory capital stringency had a negative effect on cost efficiency in the full sample and pre-global crisis periods, but appear not significant and therefore to improve in the post-crisis period, suggesting some improvement in bank efficiency.

Overall the findings were not fully consistent with other MENA banking study findings, although our focus was slightly different. For instance, the stronger performance of government banks in the MENA region, although using different measures, does not support the findings of Farazi et al. (2013). One notable aspect of our evidence is that we find inconclusive evidence in regards to the effects of ownership and bank regulation on profit efficiency of a bank. Our results suggested that cost efficiency was explained with ownership and regulatory variables more so than profit efficiency, whereas Olson and Zoubi (2011) suggested that in regards to bank efficiency and profitability, that profit efficiency was more important in the MENA region.

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Appendix A: The process of calculating the Lerner Index:

Lerner Index, $LI_{it} = \frac{P_{it} - MC_{it}}{P_{it,}}$, where P_{it} is the price of bank production measured the ratio of total revenues (interest and non-interest income) to total assets for bank *i* at time *t*, and MC_{it} is the marginal cost for bank *i* at time *t*. Marginal cost is based on following translog cost function with one output (*Q*) and three input prices (W1, W2 and W3):

$$LnCost_{it} = a_0 + a_1 \text{Ln Q}_{it} + \frac{\alpha_2}{2} \text{Ln Q}_{it}^2 + \sum_{k=1}^{3} \gamma_{kt} \text{Ln W}_{k,it} + \sum_{k=1}^{3} \text{B}_k \text{Ln Q}_{it} \text{Ln W}_{k,it} +$$

$$\sum_{k=1}^{3} + \sum_{j=1}^{3} \text{Ln W}_{k,it} \text{Ln W}_{j,it} \qquad \text{(A. 1)}$$

where *Q* = Total assets

*w*1 = price of labour (the ratio of personal expenses to total assets)

*w*2 = price of physical capital (the ratio of non-interest expenses to fixed assets)

*w*3 = price of borrowed funds (the ratio of paid interest to total funding)

The marginal cost is derived as:

$$MC_{it} = \frac{Cost_{it}}{Q_{it}} \left[a_1 + a_2 \text{Ln Q}_{it} + \sum_{k=1}^{3} \beta_k \text{Ln W}_{k,it} \right] \qquad \text{(A. 21)}$$

Equation (A.1) is estimated using fixed effect model for the whole panel of banks, since some countries have small sample size (see also Agoraki et al. 2011), and thus provided statistically

insignificant results. The Lerner index ranges from 0 to 1, with 0 indicating no market power of the bank (perfect competition) and 1 indicating the monopoly condition, where banks charge higher mark-up price over marginal cost (e.g., higher market power of the bank.

References

Agoraki, M. K., Delis, M.D. & Pasiouras, F. (2011). Regulation, competition and bank risk-taking in transition countries. *Journal of Financial Stability*, *7*, 38-48.

Allen, F., & Carletti, E. (2013). New theories to underpin financial reform. *Journal of Financial Stability, 9*, 242–249.

Awartani, B., Belkhir, M., Boubaker, S., & Maghyereh, A. (2016). Corporate debt maturity in the MENA region: Does institutional quality matter? *International Review of Financial Analysis*, 46, 309-325.

Ayadi, R., & De Groen, W. P. (2013). Banking and insurance in the GCC countries: Is there regulatory convergence with the EU? *Sharaka Research Paper No. 4*. http://www.ceps.eu/book/banking-and-insurance-gcc-countries-there-regulatory-convergence-eu Accessed 15.02.2015.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science, 30*, 8-92.

Banker, R. D., & Natarajan, R., (2008). Evaluating contextual variables affecting productivity using data envelopment analysis. *Operations Research, 56*, 48–58.

Barth, J. R., Caprio Jr., G., & Levine, R. (2001a). The regulation and supervision of bank around the world: a new database. In R.E. Litan and R. Herring (Eds.), *Integrating Emerging Market Countries into the Global Financial System* (pp. 183-240). Washington, DC: Brookings Institution Press.

Barth, J.R., Caprio Jr., G., & Levine, R. (2001b). Banking systems around the globe: Do regulation and ownership affect performance and stability? In F.S. Mishkin (Eds.), *Prudential Supervision: What Works and What Doesn't?* (pp. 31-96). Chicago: University of Chicago Press.

Barth, J.R., Caprio Jr., G., & Levine, R. (2004). Bank regulation and supervision: what works best? *Journal of Financial Intermediation, 13*, 205–248.

Barth, J.R., Caprio, G., & Levine, R. (2006). *Rethinking Bank Regulation: Till Angels Govern.* Cambridge University Press, Cambridge, UK.

Barth, J. R., Caprio Jr., G., & Levine, R. (2008). Bank regulations are changing: But for better or worse? World Bank Policy Research Working Paper no 4646. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1149579## Accessed 15.02.2015.

Barth, J. R., Lin, C., Ma, Y., Seade, J. & Song, F. M. (2013). Do bank regulation, supervision and monitoring enhance or impede bank efficiency? *Journal of Banking and Finance, 37*, 2879–2892.

Battese, G. E., & Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics*, *20*, 325–332.

Beck, T., Demirguc-Kunt, A., & Levine, R. (2006). Bank concentration, competition and crisis: First results. *Journal of Banking and Finance, 30*, 1581–1603.

Ben Naceur, S., & Omran, M. (2011). The effects of bank regulations, competition, and financial reforms on banks' performance. *Emerging Markets Review, 12,* 1-20.

Bitar, M., Saad, W., & Benlemlih, M. (2016). Bank risk and performance in the MENA region: The importance of capital requirements. *Economic Systems, 40, 398-421.* doi:10.1016/j.ecosys.2015.12.001

Bourgain, A., Pieretti, P., & Zanaj, S. (2012). Financial openness, disclosure and bank risk-taking in MENA countries. *Emerging Markets Review, 13,* 283–300.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring efficiency of decision making units. *European Journal of Operations Research, 6,* 429-444.

Chortareas, G. E., Girardone, C., & Ventouri, A. (2012). Bank supervision, regulation, and efficiency: Evidence from the European Union. *Journal of Financial Stability, 8,* 292–302.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis.* (2nd ed.). New York, Springer.

Creane, S., Goyal, R., Mobarak, A. M., & Sab, R. (2003) Financial development in the Middle East and North Africa, International Monetary Fund working paper. http://www.imf.org/external/pubs/ft/med/2003/eng/creane/ Accessed 20.06.2016.

Duarte, J., Han, X., Harford, J., & Young, L. (2008). Information asymmetry, information dissemination and the effect of regulation FD on the cost of capital. *Journal of Financial Economics, 87,* 24–44.

Farazi. S., Feyen, E., & Rocha, R. (2011). Bank ownership and performance in the Middle East and North Africa Region. *World Bank Policy Research Working Paper,* No. 5620, April. Washington: The World Bank.

Forssbæck, J. (2011). Ownership structure, market discipline, and banks' risk-taking incentives under deposit insurance. *Journal of Banking and Finance, 35,* 2666-2678. doi:10.1016/j.jbankfin.2011.02.024.

Gaganis, C., & Pasiouras, F. (2013). Financial supervision regimes and bank efficiency: International evidence. *Journal of Banking & Finance, 37,* 5463-5475. doi:10.1016/j.jbankfin.2013.04.026

Ghosh, S. (2016) Political transition and bank performance: How important was the Arab Spring? Journal of Comparative Economics, 44(2), 372–382

Haw, I.-M., Ho, S., Hu, B., & Wu, D. (2010). Concentrated control, institutions, and banking sector: an international study. *Journal of Banking and Finance, 34,* 485-497.

Iannotta, G., Nocera, G., & Sironi, A. (2007). Ownership structure, risk and performance in the European banking industry. *Journal of Banking and Finance,* 31, 2127-2149.

IMF (2008). Implementation of Basel core principles for effective banking supervision experience with assessments and implications for future work. Monetary and Capital Market Department, International Monetary Fund, Washington, DC.

Kobeissi, N., & Sun, X. (2010). Ownership structure and bank performance: Evidence from the Middle East and North Africa region. *Comparative Economic Studies, 52,* 287-323.

Koldertsova, A. (2011). The second corporate governance wave in the Middle East and North Africa. *OECD Journal: Financial Market Trends, 2,* 1-8.

La Porta, L., Lopez-de-Silanes, F. Shleifer, A., & Vishny, A. (2002). Investor protection and corporate valuation. *Journal of Finance, 57,* 1147-1170.

Laeven, L., & Levine, R. (2007). Is there a diversification discount in financial conglomerates? *Journal of Financial Economics, 85,* 331–367.

Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics, 93,* 259-275.

Lensink, R., Meesters, & Naaborg, I. (2008). Bank efficiency and foreign ownership: Do good institutions matter? *Journal of Banking and Finance, 32*, 834–844.

Micco, A., Panizza, U., & Yaez, M. (2007). Bank ownership and performance: Does politics matter? *Journal of Banking and Finance, 31*, 219-241.

Mohseni-Cheraghlou, A. (2012). Bank regulation and supervision in the Arab world. http://menablog.worldbank.org/banking-regulation-and-supervision-arab-world Accessed 02.02.2013.

OECD. (2009). Policy brief on improving corporate governance of banks in the Middle East and North Africa. Paris: Organization of Economic Cooperation and Development, November.

Olson, D., & Zoubi, T.A. (2011). Efficiency and bank profitability in MENA countries. *Emerging Markets Review*, *12*, 94–110.

Omran, M. M., Bolbol, A., & Fatheldin, A. (2008) Corporate governance and firm performance in Arab equity markets: Does ownership concentration matter? *International Review of Law and Economics*, 28, 32-45.

Otchere, I. (2005). Do privatized banks in middle- and low-income countries perform better than rival banks? An intra-industry analysis of bank privatization. *Journal of Banking and Finance*, *29*, 2067–2093.

Pasiouras, F., Tanna, S., & Zopounidis, C. (2009). The impact of banking regulation on banks' cost and profit efficiency: Cross-country evidence. *International Review of Financial Analysis*, *18*, 294–302.

Rocha, R. R. Arvai, Z. & Farazi, S. (2011). *Financial access and stability: A road map for the Middle East and North Africa*. MENA development report. World Bank, Washington, DC. http://documents.worldbank.org/curated/en/343771468052798123/Financial-access-and-stability-a-road-map-for-the-Middle-East-and-North-Africa

Sassi, H. (2013). The impact of bank regulation and institutions on efficiency in selected MENA banks. *International Journal of Economics and Finance*, *5*, 84-100.

Shehzad, C. T., De Haan, J., & Scholtens, B. (2010). The impact of ownership concentration on impaired loans and capital adequacy. *Journal of Banking and Finance, 34*, 399–408.

Shleifer, A., & Vishny, R. W. (1997). A survey of Corporate Governance. *Journal of Finance, 52*, 737-783.

Simar, L., & Wilson, P. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, *136*, 31–64.

Soedarmono, W., Machrouh, F., Tarazi, A. (2013). Bank competition, crisis and risk taking: Evidence from emerging markets in Asia. *Journal of International Financial Markets, Institutions and Money*, 23, 196–221.

Taboada, A. G. (2011). The impact of changes in bank ownership structure on the allocation of capital: International evidence. *Journal of Banking and Finance, 35*, 2528–2543.

Turk-Ariss, R. (2009). Competitive behavior in Middle East and North Africa banking systems. *The Quarterly Review of Economics and Finance, 49*, 693–710.

Turk-Ariss, R. (2010a). Competitive conditions in Islamic and conventional banking: A global perspective. *Review of Financial Economics*, *19*, 101–108.

Turk-Ariss, R. (2010b). On the implications of market power in banking: Evidence from developing countries. *Journal of Banking and Finance, 34*, 765.775.

Zhu, J. (2009). *Quantitative Models for Performance Evaluation and Benchmarking: Data Envelopment Analysis with Spreadsheets*. (2nd ed.). New York: Springer.

Table 1 Variable definitions.

Panel A: Financial intermediation model	
Output variables	
*y*1	Total loans (millions USD)
*y*2	Other earnings assets (millions USD)
*y*2	Other operating income (millions USD)
Output prices:	
*q*1	The ratio of interest income to total loans
*q*2	The ratio of non-interest income to other earnings assets
*q*2	The ratio of other operating income to total assets
Input variables:	
*x*1	Total funding (total deposits + total money market funding + other funding) (millions USD)
*x*2	Fixed assets (millions USD)
*x*3	Loan loss provisions (millions USD)
*x*4	Personnel expenses (millions USD)
Input prices:	
*p*1	The ratio of interest expenses total funding
*p*2	The ratio of non-interest expenses fixed assets
*p*3	The ratio of loan loss provisions to total loans
*p*4	Personnel expenses to total assets
Equity	The ratio of total equity to total assets
Panel B: Determinants of bank efficiency	
Capital stringency index (CS)	This variable is determined by adding 1 if the answer is yes to questions 1–6 and 0 otherwise, while the opposite occurs in the case of questions 7 and 8 (i.e. yes = 0, no = 1). (1) Is the minimum required capital asset ratio risk-weighted in line with Basel guidelines? (2) Does the ratio vary with market risk? (3–5) Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital: (a) market value of loan losses not realized in accounting books? (b) Unrealized losses in securities portfolios? (c) Unrealized foreign exchange losses? (6) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (7) Can the initial or subsequent injections of capital be done with assets other than cash or government securities? (8) Can initial disbursement of capital be done with borrowed funds?
Supervisory power index (SP)	This variable is determined by adding 1 if the answer is yes and 0 otherwise, for each one of the following questions: (1) does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (2) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authorities force a bank to change its internal organizational structure? (5) Are off-balance sheet items disclosed to supervisors? (6) Can the

	supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (7) Can the supervisory agency suspend director's decision to distribute dividends? (8) Can the supervisory agency suspend director's decision to distribute bonuses? (9) Can the supervisory agency suspend director's decision to distribute management fees? (10) Can the supervisory agency supersede bank shareholder rights and declare bank insolvent? (11) Does banking law allow supervisory agency or any other government agency (other than court) to suspend some or all ownership rights of a problem bank? (12) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than court) supersede shareholder rights? (13) Regarding bank restructuring & reorganization, can supervisory agency or any other government agency (other than court) remove and replace management? (14) Regarding bank restructuring & reorganization, can supervisory agency or any other government agency (other than court) remove and replace directors?
Activity restrictions index (AR)	The score for this variable is determined on the basis of the level of regulatory restrictiveness for bank participation in: (1) securities activities (2) insurance activities (3) real estate activities (4) bank ownership of non-financial firms. These activities can be unrestricted, permitted, restricted or prohibited that are assigned the values of 1–4, respectively. We use an overall index by calculating the average value over the four categories. Higher values indicate more restrictions.
Market discipline index (MD)	This variable is determined by adding 1 if the answer is yes to questions 1–7 and 0 otherwise, while the opposite occurs in the case of questions 8 (i.e. yes = 0, no = 1). (1) Is subordinated debt allowable (or required) as part of capital? (2) Are financial institutions required to produce consolidated accounts covering all bank and any non-bank financial subsidiaries? (3) Are off-balance sheet items disclosed to public? (4) Must banks disclose their risk management procedures to public? (5) Are directors legally liable for erroneous/misleading information? (6) Does regulation require credit ratings for commercial banks? (7) Is an external audit by certified/licensed auditor a compulsory obligation for banks? (8) Does accrued, though unpaid interest/principal enters the income statement while loan is non-performing? Higher values indicate more incentive to disclose to the market.
Deposit insurance	A dummy variable that takes a value of one if the country has deposit insurance, and zero otherwise.
Own. concentration	The ownership percentage held by the largest shareholder
Govt. ownership	Proportion of equity held by the government
Foreign ownership	Proportion of equity held by foreign investors
Market power	The Lerner index (see Appendix A)
Bank size	Natural logarithm of total assets in thousands of USD
Deposits	The ratio of deposits to total assets
Loan growth	% change in the amount of bank *i*'s total customer loans from the year *t*-1 to year *t*.
Lending	The ratio of total loans to total assets
Interest rate	Real interest rate (%)
Income level	Natural logarithm of gross domestic product (GDP) per capita of the country.
Post-GFC	A dummy variable that equals 1 for the years 2008 to 2012, and zero otherwise.
GDP Growth	The growth rate of real GDP (constant 2000 prices)
Year Dummies	Dummy variable for each of the twelve years

Note: We follow among others Agoraki et al. (2011) in constructing the indices of CS (capital stringency), SP (supervisory power), AR (activity restrictions), and MD (market discipline).

Table 2 Summary statistics.

Panel A: Variable summary statistics

	Mean	Std Dev.	Observations
Capital stringency	6.96	1.27	718
Supervisory power	12.62	1.69	718
Activity restrictions	2.49	0.41	718
Market discipline	6.91	0.86	718
Ownership concentration	0.47	0.27	718
Government ownership	0.15	0.24	718
Foreign ownership	0.28	0.35	718
Market power	0.51	0.11	718
Equity / Total assets	0.13	0.23	718
Total deposits / Total assets	0.70	0.14	717
Loan growth	17.75	23.13	716
Total loans / Total assets	0.51	0.18	718
Interest income / Total loan	0.12	0.12	718
Non-interest income / Other earnings assets	0.07	0.22	718
Other operating income / Total assets	0.00	0.01	718
Interest expenses / Total deposits	0.03	0.02	718
Loan loss provisions / Total loans	0.02	0.11	718
Non-interest expenses / Fixed assets	1.56	1.08	718
Personnel expenses / Total assets	0.01	0.00	718
GDP growth	0.05	0.04	718
Inflation rate	0.08	0.09	718
Interest rate	0.01	0.10	718

Table 2 (continued) Summary statistics.

Panel B: Summary statistics across countries

	Algeria	Bahrain	Egypt	Jordan	Saudi Arabia	Kuwait	Lebanon	Morocco	Oman	Qatar	Syria	UAE
Capital stringency	6.17	7.38	4.65	7.40	5.54	7.67	7.64	5.73	6.91	5.56	5.28	7.63
Supervisory power	13.00	13.5	13.37	10.53	13.5	10.8	12.8	12.5	13.13	11.16	13.26	13.22
Activity restrictions	2.27	2.35	2.62	2.70	2.89	2.04	2.64	2.89	2.89	1.86	2.72	2.15
Market discipline	5.54	7.00	7.61	6.53	7.00	7.57	6.13	6.95	5.98	6.92	7.00	8.00
Own. concentration	0.75	0.38	0.71	0.30	0.39	0.33	0.59	0.63	0.29	0.40	0.46	0.47
Govt. ownership	0.30	0.24	0.21	0.14	0.14	0.02	0.00	0.29	0.09	0.16	0.07	0.32
Foreign own.	0.56	0.48	0.46	0.31	0.24	0.15	0.25	0.28	0.17	0.13	0.42	0.11
Institutional own.	0.08	0.16	0.09	0.07	0.13	0.10	0.06	0.16	0.11	0.11	0.02	0.03
Bank ownership	0.53	0.37	0.52	0.22	0.20	0.22	0.25	0.44	0.29	0.12	0.46	0.10

Liquid assets	0.45	0.31	0.37	0.34	0.20	0.31	0.36	0.26	0.23	0.26	0.52	0.24
Market power	0.52	0.47	0.39	0.48	0.58	0.59	0.40	0.48	0.52	0.58	0.83	0.58
Equity / Total assets	0.20	0.17	0.09	0.12	0.13	0.12	0.10	0.08	0.13	0.16	0.19	0.17
Deposit	0.53	0.47	0.79	0.69	0.74	0.59	0.81	0.65	0.71	0.64	0.70	0.65
GDP growth	0.03	0.05	0.05	0.05	0.04	0.06	0.06	0.05	0.05	0.13	0.04	0.04

Table 3 Country-wise distribution cost and profit efficiency scores.

Countries	Cost Efficiency				Profit Efficiency				n
	Mean	Std Dev.	95% C.I. Lower bound	95% C.I. Upper bound	Mean	Std Dev.	95% C.I. Lower bound	95% C.I. Upper bound	
Algeria	0.63	0.24	0.54	0.72	0.65	0.07	0.52	0.78	31
Bahrain	0.42	0.21	0.36	0.48	0.38	0.04	0.31	0.46	55
Egypt	0.18	0.06	0.17	0.20	0.30	0.05	0.20	0.40	40
Jordan	0.34	0.12	0.31	0.36	0.28	0.02	0.24	0.32	71
Saudi Arabia	0.52	0.22	0.47	0.57	0.68	0.03	0.62	0.73	83
Kuwait	0.43	0.14	0.39	0.47	0.56	0.03	0.50	0.63	47
Lebanon	0.19	0.11	0.18	0.21	0.23	0.02	0.19	0.26	160
Morocco	0.42	0.20	0.33	0.52	0.38	0.06	0.25	0.51	20
Oman	0.44	0.09	0.41	0.48	0.34	0.02	0.31	0.38	30
Qatar	0.47	0.17	0.41	0.52	0.63	0.04	0.54	0.71	36
Syria	0.31	0.06	0.28	0.34	0.29	0.06	0.17	0.41	21
UAE	0.50	0.19	0.47	0.53	0.54	0.02	0.50	0.59	124
All	0.38	0.21	0.37	0.40	0.43	0.01	0.41	0.45	718

Table 4 Frontier regression results: Cost efficiency.

Panel A: Regulation and Ownership

	Variables	Dependent Variable: Cost Efficiency							
		1	2	3	4	5	6	7	8
Regulation	Capital stringency (CS)	0.0213***	0.0211***	0.0216***	0.0235***	0.0229***	0.0226***	0.0217***	0.0213***
		(0.0074)	(0.0076)	(0.0074)	(0.0075)	(0.0074)	(0.0073)	(0.0074)	(0.0076)
	Supervisory power (SP)	0.0136***	0.0179***	0.0116***	0.0124***	0.0132***	0.0178***	0.0129***	0.0136***
		(0.0038)	(0.0042)	(0.0039)	(0.0038)	(0.0038)	(0.0043)	(0.0038)	(0.0038)
	Activity Restriction (AR)	-0.0385*	-0.0310	-0.0452**	-0.0354*	-0.0399**	-0.0373*	-0.0408*	-0.0388*
		(0.0203)	(0.0214)	(0.0205)	(0.0206)	(0.0203)	(0.0202)	(0.0218)	(0.0205)
	Market	-0.0176*	-0.0168	-0.0162	-0.0163	-0.0146	-0.0205**	-0.0184*	-0.0167

	discipline (MD)	(0.0103)	(0.0107)	(0.0103)	(0.0104)	(0.0103)	(0.0103)	(0.0103)	(0.0107)
	Deposit insurance (DI)	-0.0872***	-0.0845***	-0.0952***	-0.0787***	-0.0833***	-0.0861***	-0.0935***	-0.0850***
		(0.0279)	(0.0279)	(0.0284)	(0.0281)	(0.0281)	(0.0278)	(0.0282)	(0.0280)
Ownership	Ownership Concentration(OC)	0.114***	0.108***	0.115***	0.116***	0.0954***	0.107***	0.118***	0.113***
		(0.0229)	(0.0250)	(0.0228)	(0.0233)	(0.0255)	(0.0229)	(0.0231)	(0.0230)
	Government ownership (Govt.)	0.0599**	0.0631**	0.0641**	0.0708**	0.0856***	0.0671**	0.0681**	0.0566*
		(0.0282)	(0.0282)	(0.0292)	(0.0286)	(0.0297)	(0.0282)	(0.0285)	(0.0294)
	Foreign own. (Foreign)	0.0049	0.0081	0.0056	0.0115	0.0212	0.0127	0.0004	0.0034
		(0.0179)	(0.0179)	(0.0181)	(0.0199)	(0.0187)	(0.0179)	(0.0192)	(0.0180)
Bank specific controls	Market power	0.530***	0.527***	0.533***	0.514***	0.522***	0.537***	0.522***	0.529***
		(0.0463)	(0.0467)	(0.0462)	(0.0471)	(0.0462)	(0.0462)	(0.0468)	(0.0469)
	Bank size	-0.0122**	-0.0128**	-0.0115**	-0.0126**	-0.0123**	-0.0120**	-0.0123**	-0.0126**
		(0.0049)	(0.0050)	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0050)	(0.0050)
	Equity	0.0020	0.0047	0.0040	0.0035	0.0033	0.0127	0.0020	0.0025
		(0.0215)	(0.0215)	(0.0214)	(0.0214)	(0.0214)	(0.0216)	(0.0214)	(0.0215)
	Deposit	-0.0753	-0.0798	-0.0725	-0.0869*	-0.0948*	-0.0787	-0.0811	-0.0708
		(0.0501)	(0.0501)	(0.0503)	(0.050)	(0.0502)	(0.0500)	(0.0506)	(0.0503)
	Loan growth	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***	0.0013***	0.0012***	0.0012***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
	Lending	0.123**	0.128***	0.121**	0.110**	0.112**	0.134***	0.127***	0.115**
		(0.0490)	(0.0491)	(0.0494)	(0.0493)	(0.0489)	(0.0488)	(0.0490)	(0.0499)
	Income level	-0.124**	-0.107**	-0.121**	-0.137***	-0.131**	-0.121**	-0.129**	-0.123**
		(0.0517)	(0.0524)	(0.0516)	(0.0519)	(0.0515)	(0.0514)	(0.0519)	(0.0521)
Macro	GDP growth	-0.0405	-0.0773	-0.0767	-0.0042	-0.0243	-0.0896	-0.0459	-0.0375
		(0.169)	(0.170)	(0.170)	(0.169)	(0.168)	(0.170)	(0.169)	(0.169)
	Interest	-0.217***	-0.200**	-0.215***	-0.224***	-0.220***	-0.199**	-0.214***	-0.217***
		(0.0811)	(0.0812)	(0.0808)	(0.0808)	(0.0807)	(0.0808)	(0.0809)	(0.0811)

Table 4 (continued) Frontier regression results: Cost efficiency.

Panel B: Interaction of ownership type and regulation

Variables	Dependent Variable: Cost Efficiency							
	1	2	3	4	5	6	7	8
OC*CS		0.0149			0.0358**			
		(0.0160)			(0.0180)			
OC*SP		0.0256**				0.0465***		
		(0.0126)				(0.0153)		
OC*AR		0.0699					-0.0106	
		(0.0614)					(0.0657)	
OC*MD		0.0167						0.0042
		(0.0263)						(0.0277)
Govt.*CS			0.0038		-0.0344			
			(0.0192)		(0.0209)			
Govt.*SP			-0.0245			-0.0366**		
			(0.0171)			(0.0179)		
Govt.*AR			0.121**				0.118*	
			(0.0572)				(0.0607)	
Govt.*MD			0.0344					0.0193

			(0.0296)					(0.0323)
Foreign*CS				-0.0306**	-0.0448***			
				(0.0134)	(0.0150)			
Foreign*SP				-0.0032		-0.0263**		
				(0.0094)		(0.0117)		
Foreign*AR				0.0031			0.0468	
				(0.0436)			(0.0454)	
Foreign*MD				-0.0280				-0.0108
				(0.0226)				(0.0248)
Constant	1.527***	1.326***	1.530***	1.622***	1.583***	1.442***	1.598***	1.519***
	(0.452)	(0.462)	(0.451)	(0.457)	(0.454)	(0.450)	(0.459)	(0.457)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	454.21	457.13	457.67	457.31	458.84	459.67	456.60	454.69
LR tests (Wald χ^2)	150.75***	1166.02***	1168.89***	1166.99***	1175.06***	1179.41***	1163.26***	153.22***
Observations	715	715	715	715	715	715	715	715
No. of banks	132	132	132	132	132	132	132	132

This table presents results based on stochastic frontier one-step maximum likelihood estimation technique. Dependent variable is cost efficiency score obtained from the Data Envelopment Analysis (DEA) model. CS, SP, AR, and MD are the indices of capital stringency, activity restrictions, supervisory power, and market discipline, respectively. Deposit insurance is a dummy variable that takes a value of one if the country has deposit insurance, and zero otherwise. Ownership concentration (OC) is the percentage of ownership held by the largest shareholder. Government ownership (Govt.) is the proportion of equity held by the government. Foreign ownership (Foreign) is the proportion of equity held by foreign investors. Market power is the Lerner index (see Appendix A). Bank size is the natural logarithm of total assets in thousands of USD. Deposits is the ratio of deposits to total assets. Loan growth is the percentage change in the amount of bank *i*'s total customer loans from the year *t*-1 to year *t*. Lending is the ratio of total loans to total assets. Interest rate is real interest rate. Income level is the natural logarithm of gross domestic product (GDP) per capita of the country. GDP Growth is the growth rate of real GDP (constant 2000 prices). Year Dummies are dummy variables for each of the twelve years. ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroscedasticity-adjusted robust standard errors.

Table 5 Frontier and truncated regression results pre and post crisis: Cost efficiency.

		Dependent Variable: Cost Efficiency					
		Frontier regressions			Truncated regressions		
	Variables	1	2	3	4	5	6
		All	Pre-GFC	Post-GFC	All	Pre-GFC	Post-GFC
Regulation	Capital stringency (CS)	0.0213***	0.0151	0.0259**	0.0213***	0.0156	0.0282***
		(0.0074)	(0.0125)	(0.0111)	(0.0061)	(0.0124)	(0.0105)
	Supervisory power (SP)	0.0136***	0.00674	0.00884*	0.0110***	0.0029	0.0060
		(0.0038)	(0.0098)	(0.0049)	(0.0029)	(0.0096)	(0.0047)
	Activity restrictions (AR)	-0.0385*	-0.0088	-0.0466*	-0.0569***	-0.0442	-0.0566**
		(0.0203)	(0.0693)	(0.0244)	(0.0170)	(0.0678)	(0.0227)
	Market discipline (MD)	-0.0176*	-0.0098	-0.0293	-0.0181**	-0.0102	-0.0122
		(0.0103)	(0.0150)	(0.0185)	(0.0070)	(0.0150)	(0.0176)
	Deposit insurance (DI)	-0.0872***	0.0690	-0.0928**	-0.0764***	0.0760	-0.0918***
		(0.0279)	(0.126)	(0.0378)	(0.0278)	(0.140)	(0.0354)
Ownership	Own. concentration (OC)	0.114***	0.0835***	0.145***	0.0830***	0.0692**	0.117***
		(0.0229)	(0.0293)	(0.0329)	(0.0285)	(0.0310)	(0.0326)
	Government ownership (Govt.)	0.0599**	0.0588	0.0319	0.0551*	0.0438	0.0310
		(0.0282)	(0.0398)	(0.0385)	(0.0305)	(0.0380)	(0.0370)
	Foreign ownership (Foreign)	0.0049	0.0087	0.0001	0.0222	0.0133	0.0142
		(0.0179)	(0.0287)	(0.0219)	(0.0242)	(0.0303)	(0.0216)
B a	Market power	0.530***	0.350***	0.586***	0.489***	0.331***	0.582***

		(0.0463)	(0.0724)	(0.0603)	(0.0538)	(0.0742)	(0.0643)
	Bank size	-0.0122**	-0.0130*	-0.00501	-0.0111*	-0.0142*	-0.00535
		(0.0049)	(0.0068)	(0.0070)	(0.0064)	(0.0072)	(0.0068)
	Equity	0.0020	0.485***	0.00319	-0.00124	0.287*	0.0009
		(0.0215)	(0.156)	(0.0222)	(0.182)	(0.166)	(0.0223)
	Deposit	-0.0753	-0.127*	-0.0209	-0.0785	-0.112	-0.0530
		(0.0501)	(0.0695)	(0.0693)	(0.0527)	(0.0734)	(0.0669)
	Loan growth	0.0012***	0.0014***	0.0015***	0.0011***	0.0014***	0.0012***
		(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
	Lending	0.123**	0.243***	0.0212	0.203***	0.216***	0.153**
		(0.0490)	(0.0756)	(0.0658)	(0.0611)	(0.0786)	(0.0653)
	Income level	-0.124**	-0.0336	-0.246**	-0.0428	0.00331	-0.0926
		(0.0517)	(0.0836)	(0.100)	(0.0377)	(0.0829)	(0.0671)
Macro	GDP growth	-0.0405	-0.528**	0.475*	-0.0208	-0.530**	0.438*
		(0.169)	(0.237)	(0.265)	(0.198)	(0.245)	(0.249)
	Interest	-0.217***	-0.490**	-0.157	-0.196**	-0.518**	-0.106
		(0.0811)	(0.229)	(0.0989)	(0.0905)	(0.232)	(0.0895)
	Post-GFC	0.287***			0.231***		
		(0.0321)			(0.0330)		
	Constant	1.240***	0.415	2.516***	0.596	0.287	1.063*
		(0.435)	(0.764)	(0.864)	(0.363)	(0.790)	(0.609)
	Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
	Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
	Log likelihood	454.21	255.00	251.24	546.76	274.05	311.14
	LR tests (Wald χ^2)	1150.75***	562.11***	786.61***	4939.07***	314.98***	430.98***
	Observations	715	308	407	699	306	393

Notes: Columns 1-3 of this table present results based on stochastic frontier one-step maximum likelihood estimation technique, whereas columns 4-6 present results based on second-stage truncated maximum likelihood estimation technique. See Table 4 for variable definitions. ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroscedasticity-adjusted robust standard errors.

Table 6 Truncated regression results: Cost efficiency.

Panel A: Regulation and Ownership

	Variables	Dependent Variable: Cost Efficiency							
		1	2	3	4	5	6	7	8
Regulation	Capital stringency (CS)	0.0213***	0.0226***	0.0217***	0.0233***	0.0233***	0.0225***	0.0217**	0.0219***
		(0.0055)	(0.0080)	(0.0070)	(0.0083)	(0.0074)	(0.0075)	(0.0085)	(0.0072)
	Supervisory power (SP)	0.0110***	0.0142***	0.0099**	0.0099***	0.0105***	0.0162***	0.0106***	0.0108***
		(0.0033)	(0.0045)	(0.0041)	(0.0036)	(0.0030)	(0.0039)	(0.0039)	(0.0038)
	Activity restrictions (AR)	-0.0569***	-0.0549***	-0.0594**	-0.0528***	-0.0578***	-0.0532***	-0.0606***	-0.0563***
		(0.0215)	(0.0200)	(0.0235)	(0.0185)	(0.0202)	(0.0206)	(0.0230)	(0.0216)
	Market discipline (MD)	-0.0181***	-0.0195**	-0.0181**	-0.0169**	-0.0152**	-0.0212***	-0.0193**	-0.0189**
		(0.0061)	(0.0085)	(0.0076)	(0.0078)	(0.0077)	(0.0077)	(0.0078)	(0.0094)
	Deposit insurance (DI)	-0.0764**	-0.0760**	-0.0783***	-0.0660**	-0.0699***	-0.0765***	-0.0771**	-0.0761**
		(0.0311)	(0.0373)	(0.0292)	(0.0272)	(0.0245)	(0.0290)	(0.0315)	(0.0320)
Ownership	Own. concentration (OC)	0.0830***	0.0830**	0.0839***	0.0852***	0.0683***	0.0790**	0.0857***	0.0819**
		(0.0287)	(0.0331)	(0.0299)	(0.0276)	(0.0244)	(0.0325)	(0.0300)	(0.0335)
	Govt. ownership (Govt.)	0.0551*	0.0569	0.0566*	0.0667*	0.0801***	0.0612**	0.0597*	0.0542
		(0.0295)	(0.0363)	(0.0311)	(0.0381)	(0.0285)	(0.0294)	(0.0305)	(0.0405)
	Foreign ownership (Foreign)	0.0222	0.0252	0.0218	0.0303	0.0407**	0.0296	0.0161	0.0212
		(0.0180)	(0.0228)	(0.0251)	(0.0220)	(0.0187)	(0.0232)	(0.0209)	(0.0266)
Bank	Market power	0.489***	0.485***	0.490***	0.473***	0.483***	0.497***	0.482***	0.485***
		(0.0680)	(0.0673)	(0.0557)	(0.0499)	(0.0677)	(0.0605)	(0.0637)	(0.0683)
	Bank size	-0.0111	-0.0115*	-0.0107	-0.0114*	-0.0116**	-0.0109	-0.0119*	-0.0108
		(0.0077)	(0.0068)	(0.0069)	(0.0065)	(0.0058)	(0.0073)	(0.0066)	(0.0076)

	Equity	-0.0012	0.0013	-0.0001	0.0007	0.0002	0.0099	-0.0010	-0.0010
		(0.195)	(0.185)	(0.159)	(0.182)	(0.203)	(0.158)	(0.174)	(0.185)
	Deposit	-0.0785	-0.0835	-0.0794	-0.0877	-0.0980*	-0.0824	-0.0855	-0.0773
		(0.0609)	(0.0703)	(0.0608)	(0.0601)	(0.0518)	(0.0654)	(0.0610)	(0.0534)
	Loan growth	0.0011***	0.0012***	0.0011***	0.0011***	0.0011***	0.0012***	0.0011***	0.0011***
		(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
	Lending	0.203***	0.205***	0.202***	0.189***	0.188***	0.216***	0.202***	0.199***
		(0.0677)	(0.0658)	(0.0494)	(0.0538)	(0.0507)	(0.0614)	(0.0514)	(0.0549)
	Income level	-0.0428	-0.0450	-0.0381	-0.0548	-0.0496	-0.0545	-0.0461	-0.0459
		(0.0473)	(0.0433)	(0.0481)	(0.0483)	(0.0478)	(0.0451)	(0.0559)	(0.0462)
Macro	GDP growth	-0.0208	-0.0257	-0.0446	0.0218	-0.0021	-0.0458	-0.0256	-0.0139
		(0.162)	(0.190)	(0.133)	(0.137)	(0.163)	(0.167)	(0.125)	(0.141)
	Interest	-0.196***	-0.187**	-0.197***	-0.201***	-0.198***	-0.178***	-0.197***	-0.198***
		(0.0696)	(0.0784)	(0.0739)	(0.0636)	(0.0746)	(0.0658)	(0.0705)	(0.0766)

Table 6 (continued) Truncated regression results: Cost efficiency.

Panel B: Interaction of ownership type and regulation

Variables	Dependent Variable: Cost Efficiency							
	1	2	3	4	5	6	7	8
OC*CS		0.0052			0.0324*			
		(0.0154)			(0.0175)			
OC*SP		0.0252**				0.0503***		
		(0.0111)				(0.0155)		
OC*AR		0.0073					-0.0400	
		(0.0598)					(0.0731)	
OC*MD		-0.0080						-0.0089
		(0.0314)						(0.0372)
Govt*CS			0.00724		-0.0288			
			(0.0206)		(0.0230)			
Govt.*SP			-0.0136			-0.0314		
			(0.0203)			(0.0211)		
Govt.*AR			0.0564				0.0679	
			(0.0573)				(0.0655)	
Govt.*MD			0.0114					0.0089
			(0.0382)					(0.0313)
Foreign*CS				-0.0347***	-0.0494***			
				(0.0132)	(0.0180)			
Foreign*SP				-0.0077		-0.0321***		
				(0.0098)		(0.0118)		
Foreign*AR				0.0087			0.0505	
				(0.0582)			(0.0496)	
Foreign*MD				-0.0214				-0.0061
				(0.0227)				(0.0291)
Constant	0.827*	0.808*	0.805*	0.911**	0.881**	0.844**	0.894*	0.855*
	(0.452)	(0.426)	(0.454)	(0.427)	(0.424)	(0.398)	(0.520)	(0.452)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	546.76	548.93	547.63	550.86	551.71	553.01	547.81	546.95
LR tests (Wald $\chi 2$)	5259.08***	6122.80***	3890.17***	4117.59***	4459.26***	5548.79***	5203.35***	3153.42***
Observations	699	699	699	699	699	699	699	699
No. of banks	132	132	132	132	132	132	132	132

Notes: This table presents results based on second-stage truncated maximum likelihood estimation technique. ***, ** and * indicate statistical significance at 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroscedasticity-adjusted robust standard errors. Dependent variable is cost efficiency score obtained from the Data Envelopment Analysis (DEA) model. See Table 4 for variable definitions.

Table 7 Frontier regression results: Pre-global crisis (GFC).

	Dependent variable: Cost efficiency	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Regulation	Capital stringency (CS)	0.0171	0.0086	0.0260**	0.0185	0.0197	0.0127	0.0124
		(0.0148)	(0.0127)	(0.0129)	(0.0128)	(0.0128)	(0.0128)	(0.0133)
	Supervisory power (SP)	0.0118	0.0107	0.0039	0.0068	0.0089	0.0118	0.0076
		(0.0104)	(0.0098)	(0.0097)	(0.0099)	(0.0101)	(0.0103)	(0.0098)
	Activity restriction (AR)	-0.0143	0.0445	-0.0116	-0.0040	-0.0193	-0.00122	0.0102
		(0.0702)	(0.0701)	(0.0699)	(0.0695)	(0.0707)	(0.0699)	(0.0695)
	Market discipline (MD)	-0.0106	-0.0119	-0.0077	-0.0061	-0.0117	-0.0086	-0.00758
		(0.0156)	(0.0153)	(0.0149)	(0.0149)	(0.0150)	(0.0148)	(0.0153)
	Deposit insurance (DI)	0.0780	0.152	0.0517	0.106	0.0660	0.0788	0.0709
		(0.131)	(0.126)	(0.126)	(0.127)	(0.127)	(0.129)	(0.127)
Ownership	Ownership conc. (OC)	0.0655	0.0953***	0.0866***	0.0576	0.0654**	0.0795***	0.0934***
		(0.0400)	(0.0292)	(0.0296)	(0.0384)	(0.0311)	(0.0294)	(0.0300)
	Government own. (Govt.)	0.0523	0.0609	0.0997**	0.104**	0.0661	0.0654*	0.0722*
		(0.0403)	(0.0498)	(0.0412)	(0.0449)	(0.0506)	(0.0392)	(0.0409)
	Foreign own. (Foreign)	0.0155	-0.0025	0.0422	0.0618*	0.0138	0.0109	-0.0031
		(0.0295)	(0.0287)	(0.0360)	(0.0367)	(0.0291)	(0.0287)	(0.0305)
Bank specific	Market power	0.349***	0.365***	0.320***	0.344***	0.355***	0.368***	0.317***
		(0.0730)	(0.0715)	(0.0758)	(0.0716)	(0.0735)	(0.0720)	(0.0758)
	Bank size	-0.0142**	-0.0132**	-0.0136**	-0.0131*	-0.0132*	-0.0128*	-0.0165**
		(0.0068)	(0.0066)	(0.0068)	(0.0067)	(0.0069)	(0.0067)	(0.0069)
	Equity	0.528***	0.527***	0.564***	0.551***	0.529***	0.489***	0.532***
		(0.157)	(0.153)	(0.156)	(0.155)	(0.158)	(0.155)	(0.157)
	Deposits	-0.122*	-0.140**	-0.116*	-0.124*	-0.114	-0.142**	-0.132*
		(0.0695)	(0.0700)	(0.0690)	(0.0685)	(0.0700)	(0.0686)	(0.0702)
	Loan growth	0.0013***	0.0014***	0.0012***	0.0013***	0.0013***	0.0015***	0.0013***
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
	Lending	0.255***	0.202***	0.217***	0.225***	0.264***	0.233***	0.223***
		(0.0763)	(0.0768)	(0.0773)	(0.0755)	(0.0762)	(0.0759)	(0.0782)
Macro	Income level	-0.0458	-0.0342	-0.0381	-0.0324	-0.0558	-0.0303	-0.0315
		(0.0843)	(0.0823)	(0.0824)	(0.0826)	(0.0842)	(0.0826)	(0.0833)
	GDP growth	-0.507**	-0.625***	-0.453*	-0.493**	-0.475**	-0.615***	-0.527**
		(0.237)	(0.234)	(0.236)	(0.234)	(0.238)	(0.235)	(0.235)
	Interest	-0.512**	-0.519**	-0.559**	-0.539**	-0.523**	-0.486**	-0.484**
		(0.231)	(0.226)	(0.227)	(0.227)	(0.229)	(0.227)	(0.228)
	OC*CS	0.00871			0.0336			
		(0.0254)			(0.0278)			
	OC*SP	0.00994					0.0406	
		(0.0204)					(0.0284)	
	OC*AR	-0.129				-0.160		
		(0.101)				(0.0988)		
	OC*MD	0.0143						0.0555*
		(0.0341)						(0.0330)
	Govt.*CS		0.0715*		-0.00935			
			(0.0385)		(0.0306)			
	Govt.*SP		-0.0821***				-0.105***	
			(0.0305)				(0.0323)	
	Govt.*AR		0.0268			0.0505		
			(0.0964)			(0.106)		
	Govt.*MD		-0.0511					-0.0239
			(0.0547)					(0.0369)
	Foreign*CS			-0.0623***	-0.0709***			
				(0.0217)	(0.0259)			
	Foreign*SP			0.00643			-0.0356	
				(0.0162)			(0.0240)	
	Foreign*AR			-0.0887		-0.0195		
				(0.0800)		(0.0883)		
	Foreign*MD			-0.0369				-0.0566
				(0.0329)				(0.0351)
	Constant	0.452	0.256	0.411	0.305	0.551	0.310	0.408
		(0.767)	(0.756)	(0.753)	(0.757)	(0.765)	(0.758)	(0.762)
	Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Log likelihood	256.89	261.26	260.46	260.06	256.76	260.38	257.06
	LR tests (Wald χ^2)	572.85***	598.24***	593.54***	591.15***	572.14***	593.03***	573.82***
	Observations	308	308	308	308	308	308	308

Notes: This table presents results based on stochastic frontier one-step maximum likelihood estimation technique. Variable definitions are available in Table 4. ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively. Figures in parentheses are the heteroscedasticity-adjusted robust standard errors.

Table 8 Frontier regression results: Post-global crisis (GFC).

	Dependent variable: Cost efficiency	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Regulation	Capital stringency (CS)	0.0309***	0.0298***	0.0269**	0.0275**	0.0290**	0.0267**	0.0276**
		(0.0114)	(0.0114)	(0.0112)	(0.0112)	(0.0115)	(0.0111)	(0.0112)
	Supervisory power (SP)	0.0119**	0.0070	0.0082	0.0084*	0.0082*	0.0132**	0.0074
		(0.0054)	(0.0053)	(0.0050)	(0.0049)	(0.0049)	(0.0056)	(0.0051)
	Activity restriction (AR)	-0.0258	-0.0504**	-0.0391	-0.0417*	-0.0373	-0.0410*	-0.0455*
		(0.0267)	(0.0248)	(0.0248)	(0.0250)	(0.0272)	(0.0243)	(0.0248)
	Market discipline (MD)	-0.0274	-0.0260	-0.0302	-0.0257	-0.0316*	-0.0340*	-0.0284
		(0.0186)	(0.0186)	(0.0190)	(0.0187)	(0.0186)	(0.0185)	(0.0187)
	Deposit insurance (DI)	-0.0958**	-0.0868**	-0.0885**	-0.0912**	-0.0936**	-0.0928**	-0.0896**
		(0.0377)	(0.0384)	(0.0380)	(0.0382)	(0.0381)	(0.0376)	(0.0379)
Ownership	Ownership concentration (OC)	0.123***	0.148***	0.149***	0.134***	0.150***	0.135***	0.150***
		(0.0362)	(0.0328)	(0.0338)	(0.0342)	(0.0345)	(0.0329)	(0.0333)
	Government ownership (Govt.)	0.0344	-0.0020	0.0311	0.0396	0.0297	0.0358	0.0114
		(0.0382)	(0.0432)	(0.0390)	(0.0399)	(0.0385)	(0.0391)	(0.0410)
	Foreign ownership (Foreign)	0.0029	-0.0050	-0.0108	0.0025	-0.0135	0.0084	-0.0042
		(0.0218)	(0.0221)	(0.0271)	(0.0223)	(0.0259)	(0.0219)	(0.0221)
Bank specific controls	Market power	0.582***	0.592***	0.576***	0.582***	0.567***	0.596***	0.587***
		(0.0613)	(0.0605)	(0.0611)	(0.0610)	(0.0613)	(0.0600)	(0.0609)
	Bank size	-0.0053	-0.0049	-0.0049	-0.0053	-0.0042	-0.0045	-0.0035
		(0.0072)	(0.0070)	(0.0071)	(0.0071)	(0.0071)	(0.0070)	(0.0072)
	Equity	0.0057	0.0038	0.0052	0.0034	0.0029	0.0123	0.0029
		(0.0221)	(0.0221)	(0.0222)	(0.0222)	(0.0221)	(0.0223)	(0.0222)
	Deposit	-0.0204	-0.0105	-0.0252	-0.0231	-0.0358	-0.0144	-0.0143
		(0.0697)	(0.0693)	(0.0710)	(0.0706)	(0.0698)	(0.0690)	(0.0698)
	Loan growth	0.0015***	0.0015***	0.0015***	0.0015***	0.0015***	0.0016***	0.0015***
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
	Lending	0.0229	0.0037	0.0120	0.0120	0.0191	0.0269	-0.0043
		(0.0662)	(0.0662)	(0.0661)	(0.0660)	(0.0656)	(0.0657)	(0.0670)
Macro	Income level	-0.226**	-0.235**	-0.262***	-0.232**	-0.248**	-0.255**	-0.240**
		(0.101)	(0.101)	(0.102)	(0.101)	(0.100)	(0.101)	(0.100)
	GDP growth	0.448*	0.497*	0.509*	0.463*	0.497*	0.446*	0.505*
		(0.265)	(0.268)	(0.267)	(0.267)	(0.265)	(0.267)	(0.265)
	Interest	-0.138	-0.148	-0.165*	-0.153	-0.152	-0.142	-0.159
		(0.0991)	(0.0988)	(0.0990)	(0.0989)	(0.0988)	(0.0984)	(0.0989)
	OC*CS	0.0301			0.0333			
		(0.0235)			(0.0240)			
	OC*SP	**0.0259***					**0.0428****	
		(0.0157)					**(0.0183)**	
	OC*AR	0.117				0.0536		
		(0.0909)				(0.0929)		
	OC*MD	0.0095						-0.0465
		(0.0466)						(0.0430)
	GOVT*CS		0.0354		-0.0124			
			(0.0301)		(0.0289)			
	GOVT*SP		-0.0142				-0.0200	
			(0.0222)				(0.0225)	
	GOVT*AR		0.116			0.0327		
			(0.0870)			(0.0812)		
	GOVT*MD		0.0930*					0.0753
			(0.0477)					(0.0490)
	Foreign*CS			-0.0054	-0.0183			
				(0.0186)	(0.0196)			
	Foreign*SP			-0.0098			-0.0270**	
				(0.0114)			(0.0134)	
	Foreign*AR			0.0566		0.0600		
				(0.0582)		(0.0578)		
	Foreign*MD			-0.0203				0.0062
				(0.0346)				(0.0351)
	Constant	2.228**	2.400***	2.634***	2.363***	2.525***	2.518***	2.439***
		(0.874)	(0.865)	(0.869)	(0.878)	(0.862)	(0.868)	(0.868)
	Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Log likelihood	254.00	253.41	252.66	252.25	252.49	254.41	252.94

LR tests (Wald χ^2)	802.98***	799.41***	795.05***	792.56***	793.94***	805.38***	796.65***
Observations	407	407	407	407	407	407	407

Notes: This table presents results based on stochastic frontier one-step maximum likelihood estimation technique. Variable definitions are available in Table 4. ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroscedasticity-adjusted robust standard errors.

Table 9 Frontier regression results: Profit efficiency**.**

Panel A: Regulation and Ownership

	Variables	Dependent Variable: Profit Efficiency							
		1	2	3	4	5	6	7	8
Regulation	Capital stringency (CS)	0.0030	0.0033	0.001	0.0083	0.0023	0.0021	0.0036	0.0041
		(0.010)	(0.0110)	(0.0107)	(0.0109)	(0.0108)	(0.0107)	(0.0108)	(0.0109)
	Supervisory power (SP)	0.0008	0.0027	0.0019	-0.0012	0.0010	0.0015	0.0027	0.0005
		(0.0055)	(0.0062)	(0.0057)	(0.0055)	(0.0055)	(0.0055)	(0.0063)	(0.0055)
	Activity restrictions (AR)	-0.0014	-0.0129	-0.0034	0.0060	0.0013	-0.0036	-0.0015	-0.0010
		(0.0294)	(0.0310)	(0.0296)	(0.0297)	(0.0296)	(0.0316)	(0.0294)	(0.0293)
	Market discipline (MD)	-0.0142	-0.0144	-0.00928	-0.0160	-0.0151	-0.0152	-0.0147	-0.0103
		(0.0149)	(0.0155)	(0.0149)	(0.0150)	(0.0150)	(0.0149)	(0.0150)	(0.0153)
	Deposit insurance	-0.0758*	-0.0723*	-0.0585	-0.0687*	-0.0721*	-0.0639	-0.0741*	-0.0648
		(0.0404)	(0.0404)	(0.0409)	(0.0405)	(0.0409)	(0.0409)	(0.0405)	(0.0402)
Ownership	Own. Concentration (OC)	0.0419	0.0383	0.0405	0.0356	0.0467	0.0417	0.0418	0.0355
		(0.0331)	(0.0363)	(0.0329)	(0.0336)	(0.0371)	(0.0334)	(0.0333)	(0.0330)
	Govt. ownership (Govt.)	0.0474	0.0469	0.0156	0.0615	0.0368	0.0400	0.0479	0.0363
		(0.0409)	(0.0409)	(0.0422)	(0.0412)	(0.0432)	(0.0412)	(0.0411)	(0.0421)
	Foreign ownership (Foreign)	-0.0353	-0.0326	-0.0443*	-0.0385	-0.0415	-0.0462*	-0.0332	-0.0433*
		(0.0259)	(0.0260)	(0.0260)	(0.0287)	(0.0273)	(0.0279)	(0.0261)	(0.0258)
	Market power	1.280***	1.288***	1.291***	1.247***	1.281***	1.280***	1.279***	1.272***
		(0.0670)	(0.0677)	(0.0667)	(0.0680)	(0.0672)	(0.0677)	(0.0673)	(0.0672)
Bank specific controls	Bank size	0.0183**	0.0167**	0.0176**	0.0166**	0.0180**	0.0164**	0.0180**	0.0160**
		(0.0071)	(0.0073)	(0.0071)	(0.0071)	(0.0072)	(0.0072)	(0.0072)	(0.0072)
	Equity	0.0047	0.0072	0.0053	0.0074	0.0046	0.0057	0.0062	0.0079
		(0.0311)	(0.0311)	(0.0309)	(0.0309)	(0.0311)	(0.0310)	(0.0314)	(0.0308)
	Deposit	0.0270	0.0312	0.0449	0.0232	0.0301	0.0194	0.0263	0.0501
		(0.0725)	(0.0726)	(0.0725)	(0.0733)	(0.0731)	(0.0732)	(0.0728)	(0.0722)
	Loan growth	0.0010***	0.0010***	0.0009***	0.0009***	0.0009***	0.0010***	0.0010***	0.0009***
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
	Lending	-0.169**	-0.168**	-0.206***	-0.200***	-0.170**	-0.178**	-0.167**	-0.209***
		(0.0709)	(0.0713)	(0.0713)	(0.0712)	(0.0712)	(0.0709)	(0.0710)	(0.0716)
	Income level	0.0779	0.0738	0.0933	0.0582	0.0811	0.0723	0.0801	0.0779
		(0.0747)	(0.0760)	(0.0744)	(0.0749)	(0.0749)	(0.0751)	(0.0750)	(0.0746)
Macro	GDP growth	-0.208	-0.190	-0.195	-0.183	-0.207	-0.194	-0.208	-0.192
		(0.244)	(0.246)	(0.246)	(0.244)	(0.245)	(0.245)	(0.248)	(0.242)
	Interest	-0.111	-0.111	-0.114	-0.125	-0.114	-0.122	-0.104	-0.116
		(0.117)	(0.118)	(0.117)	(0.117)	(0.117)	(0.117)	(0.118)	(0.116)

Table 9 (continued) Frontier regression results: Profit efficiency.

Panel B: Interaction Regulation and Ownership

OC*CS	0.0002	-0.0065				
	(0.0232)	(0.0261)				
OC*SP	0.0124			0.0138		
	(0.0182)			(0.0223)		
OC*AR	-0.0991		-0.0913			
	(0.0891)		(0.0950)			
OC*MD	0.0026					0.0270

		(0.0382)						(0.0397)
Govt*CS			-0.0088		0.0264			
			(0.0278)		(0.0304)			
Govt.*SP			-0.0016				0.0010	
			(0.0246)				(0.0261)	
Govt.*AR			-0.110			-0.0868		
			(0.0825)			(0.0879)		
Govt.*MD			0.121***					0.0837*
			(0.0428)					(0.0464)
Foreign*CS				-0.0139	0.0087			
				(0.0193)	(0.0219)			
Foreign*SP				0.0045			-0.0015	
				(0.0136)			(0.0171)	
Foreign*AR				0.0137		0.0544		
				(0.0630)		(0.0657)		
Foreign*MD				-0.0976***				-0.0799**
				(0.0327)				(0.0356)
Constant	-0.801	-0.758	-0.948	-0.618	-0.829	-0.721	-0.845	-0.797
	(0.653)	(0.670)	(0.650)	(0.657)	(0.660)	(0.662)	(0.656)	(0.654)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	190.24	191.22	195.63	195.02	190.63	192.13	190.49	197.28
LR tests (Wald χ^2)	1125.47***	1130.51***	1153.42***	1150.22***	1127.44***	1135.19***	1126.76***	1162.06***
Observations	715	715	715	715	715	715	715	715
No. of banks	132	132	132	132	132	132	132	132

Notes: This table presents results based on stochastic frontier one-step maximum likelihood estimation technique. Variable definitions are available in Table 4. ***, ** and * indicate statistical significance at 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroscedasticity-adjusted robust standard errors.

Table 10 Frontier regression results: Profit efficiency.

	Variables	Dependent Variable: Profit Efficiency		
		1	2	3
		All	Pre-GFC	Post-GFC
Regulation	Capital stringency (CS)	0.0030	0.0104	0.0128
		(0.0107)	(0.0195)	(0.0164)
	Supervisory power (SP)	0.0008	0.0161	-0.0027
		(0.0055)	(0.0153)	(0.0073)
	Activity restrictions (AR)	-0.0014	0.137	-0.0094
		(0.0294)	(0.108)	(0.0361)
	Market discipline (MD)	-0.0142	0.0005	-0.0311
		(0.0149)	(0.0233)	(0.0274)
	Deposit insurance (DI)	-0.0758*	0.174	-0.112**
		(0.0404)	(0.196)	(0.0560)
Ownership	Own. concentration (OC)	0.0419	0.124***	-0.0006
		(0.0331)	(0.0455)	(0.0486)
	Govt. ownership (Govt.)	0.0474	0.0827	0.0491
		(0.0409)	(0.0618)	(0.0569)
	Foreign ownership (Foreign)	-0.0353	-0.134***	-0.0040

		(0.0259)	(0.0446)	(0.0323)
	Market power	1.280***	1.176***	1.295***
		(0.0670)	(0.112)	(0.0892)
	Bank size	0.0183**	0.0026	0.0248**
		(0.0071)	(0.0106)	(0.0105)
	Equity	0.0047	-0.0495	0.0071
		(0.0311)	(0.242)	(0.0328)
	Deposit	0.0270	-0.0645	0.0743
		(0.0725)	(0.108)	(0.102)
Bank specific controls	Loan growth	0.0010***	0.0015***	0.0008*
		(0.0003)	(0.0004)	(0.0004)
	Lending	-0.169**	-0.212*	-0.284***
		(0.0709)	(0.117)	(0.0973)
	Income level	0.0779	0.274**	0.199
		(0.0747)	(0.130)	(0.149)
Macro	GDP growth	-0.208	-0.457	0.0954
		(0.244)	(0.368)	(0.393)
	Interest	-0.111	0.273	-0.0281
		(0.117)	(0.357)	(0.146)
	Post-GFC	-0.0917**		
		(0.0464)		
	Constant	-0.710	-2.819**	-1.799
		(0.629)	(1.190)	(1.283)
	Year Dummies	Yes	Yes	Yes
	Country Dummies	Yes	Yes	Yes
	Log likelihood	190.24	119.15	91.98
	LR tests (Wald χ^2)	1125.47***	665.34***	575.54***
	Observations	715	308	407

Notes: This table presents results based on stochastic frontier one-step maximum likelihood estimation technique. Variable definitions are available in Table 4. ***, ** and * indicate statistical significance at 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroscedasticity-adjusted robust standard errors.

Highlights:

- Considers effects of bank regulation and supervision on bank efficiency in MENA.
- Public rather than private view of bank regulation supported with cost efficiency.
- Despite imperfect market competition, positive effects on cost/profit efficiency.
- Ownership concentration had positive effects but government owned results mixed.
- Positive improvements since the global crisis in a number of areas.